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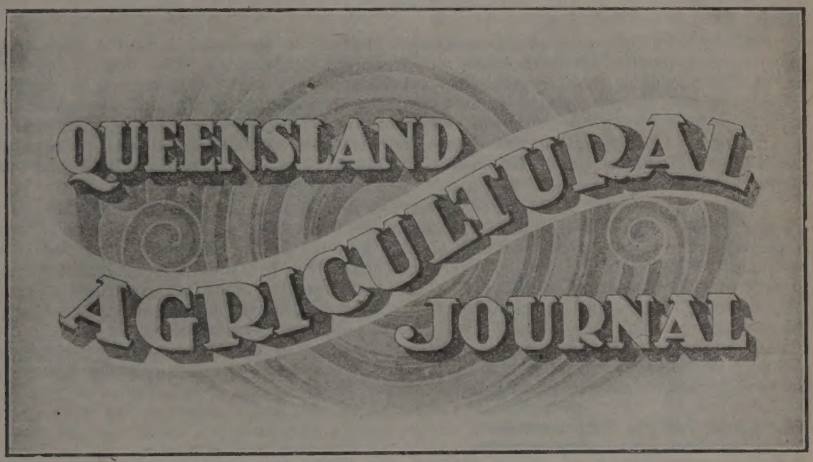

VOL. XXXVI. 1 DECEMBER, 1931. PART 6.

Event and Comment.

Dairy Production in Queensland.

MR. GRAHAM, Under Secretary for Agriculture and Stock, in his annual report to the Minister (Hon. Harry F. Walker) mentions the remarkable development in the dairying industry in Queensland, and his comprehensive review of rural progress covers many points of interest, not only to primary producers but to the community in general. He states that the excellent butter output of the 1929-30 term, until then our peak year in dairy production, was exceeded by 16,790,490 lb. The total quantity of butter manufactured was 92,894,101 lb., eloquent evidence of the remarkable progress of the dairying industry in this State. Seasonal conditions were generally favourable, and consequently production was uniform throughout the period.

Home consumption figures showed a slight decline, and oversea markets fluctuated considerably. The industry, like all others, was affected by the general economic situation. The first half of the year was a period of falling values, bottom being reached in December; from then on a recovery was made, to be followed by a depression to the mid-year level in the closing month of the term.

A very satisfactory feature of the year in dairying was a decided enhancement in the quality of the product. The actual percentages were 88.19 for choice and first, 8.26 for second, and 3.55 for third grade. It is obvious, however, that there still exists room for grade improvement, and educative effort by the Department is being directed unremittingly to the gradual elimination of the lower grades. Quality improvement is, however, a progressive factor in the industry, as will be confirmed by reference to previous annual reports.

It is being brought right home to the producer that products below grade mean a direct personal loss, and as a consequence modern methods in dairy practice are being adopted more widely.

Throughout the year a greater uniformity in condition, body, and texture of butter, and maintenance of moisture content were observed. There was more uniformity in colour and salting also in packing and finish. All this is evidence of a high standard of factory efficiency which is characteristic of the industry in this State.

A remarkable point about dairy production in Queensland is its extending development on the tropical coast and northern tablelands. The quality of the butter produced in those regions has attained a very high standard; in fact, the butter submitted for export from far northern districts comprised 99 per cent. of choice and first grade. In the continuous and fresh butter class at this year's dairy show in Brisbane, butter from the Atherton Tableland gained the highest award. The industry in the North has already become a favourable influence in our export trade.

Cheese production also showed a marked increase in the first half of the year, in comparison with the output of the corresponding period in the previous term, but later months showed a decline due to the depreciation in market values for this commodity. In spite of this, however, the output for the year was 1,272,422 lb. in excess of the production of 1929-30. The total quantity manufactured for the year was 13,642,237 lb. Cheese grading results show a general improvement in quality. The assistance of Departmental officers was always available where defects in treatment or manufacture existed, and an excellent spirit of co-operation between officials and manufacturers was maintained. This mutual understanding and service is having undoubtedly a marked influence for good.

Herd and Pasture Improvement.

HERD improvement, of course, claimed the active and continuous interest of the Department with gratifying results to the industry as a whole. Breeders of purebred stock are increasing in number, and their enterprise is meeting with its due reward. The system of production recording operated by the Department is well supported, and the influence of these activities on the dairy herds of the State is already being made manifest. Stock submitted for production recording during the year increased approximately 100 per cent. in number over previous listings. The same applies in large measure to grade herds. Generally there is a greater demand for high-quality stock.

In pasture improvement, Departmental effort has been spread more widely, and experiments in renovation and rotational grazing are in progress. In this work, dairy farmers are showing an appreciable interest.

It is regrettable, however, that fodder conservation is not being practised to the extent that the interests of the industry make imperative. Dairy farmers possess the common human characteristic of a short memory, in seasons of plenty, of previous hard times, and lay up little store for the lean years that will inevitably recur. The old-established principle of fodder conservation when stock food is abundant, though no doubt duly appreciated, is applied in practice all too rarely. The importance of this form of live stock and cheque-book insurance is stressed strongly and continuously by the Department in carrying out its comprehensive educational programme.

Factory Efficiency.

ON the technical side of the dairying industry it was a year of remarkable progress, and it is not extravagant to claim that in few countries, if any, is the industry better served. In addition to the modernisation of the existing plants, complete new factories were erected at Wondai, Beaudesert, and Kingston, and all are impressive examples of the high standards of technical and scientific efficiency attained by the Queensland dairy industry.

Dairying, like other primary industries, is feeling the influence of the present-day "back to the land" movement. The regularity of its returns and other economic advantages, in the circumstances, are attracting, no doubt, the greater number who are responding to the call of rural life in this period of national reconstruction. Share dairying and the leasing of dairy lands are extending where other systems of settlement are not available. Many landowners outside the dairying ranks who have felt the pinch of lower prices in other branches of husbandry are also being attracted to the industry by its prospect of more stabilised values.

It is noticeable, however, that the general advance in efficient dairy management is not so much in evidence on the dual-controlled farm as on that of the owner-dairyman. On the whole, the dairy farmer working his own property is to-day the most prosperous and contented producer in rural industry.

Pig Raising.

COMMENTING on conditions in the pig raising industry during the year, Mr. Graham said that seasonal circumstances were favourable throughout the districts in which the industry is carried on. Standards are improving and production was well maintained. Prices for pigs, unfortunately, fell far below the values of previous years, and as much as 50 per cent. under the 1929 level. In the last month of the year, however, values advanced from 3½d. a lb. to 4½d. a lb. for prime baconers, but according to computations of two years ago, when it was considered that 7d. a lb. dressed weight was the lowest price acceptable for best baconers consistent with reasonably profitable production, those prices were well under cost. The frozen pork trade provided fair prospects for greater development, and overseas consignments won high commendation on the London market where, in October, porkers brought from 6¾d. to 8½d. ex store, and baconers from 6¾d. to 8¾d. c.i.f.e. Though these values were not constant, they indicate the export possibilities under normal business conditions. The economic circumstances of the industry were studied closely, and every encouragement given to co-operative effort and service.

With the object of gaining data for the guidance of farmers, pig-feeding experiments were conducted at the Yeerongpilly Stock Experiment Station, the results of which have been duly disseminated. A system of regular inspection of pigs and piggeries by dairy and stock inspectors, with the object of improving general practice in the industry, was instituted in the course of the year. The system is working well, and producers are co-operating actively in it and conforming cheerfully to requirements of the Department. To date over 2,000 inspections have been made. That departmental efforts under the scheme are appreciated by the producers is evident in improvements of both stock and their environment.

In the North the industry is progressing along sound lines, and pig raising in that division of the State is now well established.

The total value of the industry for the calendar year (1930) was £1,702,000. Pigs numbered 217,528, as compared with 236,037 at the end of 1929.

Departmental Publicity.

ANOTHER interesting phase of the year's work to which reference was made by Mr. Graham in the course of his annual review was the dissemination of agricultural information to farmers. He said:—

> A system of effective publicity is recognised as one of the essential activities of the Department, and in this regard an extensive and efficient service was maintained throughout the year.
>
> The "Queensland Agricultural Journal" has now completed its thirty-fourth year of publication. In recent years it has doubled in circulation, and it continues to fulfil satisfactorily the purposes for which it was established in 1897. The journal maintains a high standard of useful service in the regular dissemination of information of practical value to the farmer and stockbreeder. It serves as an effective means of making known facts to farmers on various phases of rural industry.
>
> Exact knowledge is necessary if agriculture is to be made adaptable to the constant changes in its natural and economic environment. The latest discoveries and developments in the science and practice of agriculture must be conveyed to the farmer in a readable and readily digestible form, and that is the function of the journal and other departmental publications.
>
> The value of scientific research is recognised by all progressive agriculturists. Comprehending the objects and methods of research, for which the farm is the natural laboratory, it is they who are its most efficient supporters. Through it they know that time can be saved and their efforts directed into profitable channels, and useless struggles and waste avoided. They also know that scientific discovery is one of those things that soon becomes known throughout the world, and if we fail to make use of new knowledge, competing countries assuredly will not. By means of the journal, and our other publications, that need for information, both scientific and technical, is met so far as it comes within the scope of departmental activities. Dealing with all those phases of agriculture which are bracketed with its scientific, practical and economic interests and progress, the journal is of definite value to all engaged in primary production. Its usefulness is assured by regular contributions, many of which are the results of original research, from officers engaged in directive, educative, and specialised work.

THE QUEENSLAND SUGAR INDUSTRY.

By H. T. EASTERBY, Director, Bureau of Sugar Experiment Stations.

PART XXI.

(f) Sugar Prices.

THE price of sugar since the industry was first started in Queensland has been subject to many fluctuations, and it is now exceedingly difficult to get particulars as to old-time prices.

The prices received by the Alexandra Plantation at Mackay for sugar, according to "A Report on the Sugar Industry in Queensland," by Mr. H. Ling Roth, are given as under:—

Year.	Nett Return Per Ton. £ s. d.	Year.	Nett Return Per Ton. £ s. d.
1868	32 0 0	1874	18 5 1
1869	31 14 0	1875	22 16 1
1870	28 16 0	1876	24 8 3
1871	25 19 9	1877	21 4 9
1872	25 5 10	1878	20 5 3
1873	24 0 0		

It is not stated whether these prices were obtained for brown or white sugars, but it is pointed out that in the earlier years Queensland profited by protection, but when export began the balance of the sugars manufactured above the amount consumed in Queensland fell to its value on the world's market.

The next information I have been able to secure is from Messrs. James Stodart and Company, merchants, of Brisbane, who have kindly supplied the following figures for Yengarie white sugar:—

AVERAGE PRICE OF YENGARIE (QUEENSLAND) SUGARS FROM 1876 TO 1883.

Year.	Price. £ s. d.	Year.	Price. £ s. d.
1876	35 5 6	1880	32 4 1
1877	35 14 3	1881	32 10 1
1878	34 15 0	1882	33 5 0
1879	32 8 6	1883	31 18 8

Mr. E. B. Forrest, in giving evidence before the 1889 Royal Commission, stated he was Managing Director, Parbury, Lamb, and Company, who were agents for the Colonial Sugar Refining Company. He had been connected with the company for thirty years, and the agency had extended over the plantations of the company in Queensland since they had been established.

In connection with the price of sugar he had classified the sugars into three sorts—whites, yellows, and rations. The prices from 1882 to 1889 had ranged as under:—

Year.	First Whites.	Second Whites.	Yellow Sugars.	Ration Sugars.
	Per ton.	Per ton.	Per ton.	Per ton.
1882 ..	£36 to £28	£28 to £23	£24 to £20	£22 to £16
1883 ..	£34 to £28	£27 to £25	£27 to £19	£17 to £14
1884 ..	£30 to £20	£26 to £18	£24 to £14	£13 to £10
1885 ..	£20 to £18	£19 to £17	£17 to £13	£10
1886 ..	£20	£19	£14 to £11	£11 to £10
1887 ..	£26 to £27	£25 to £14 10s.	£15 to £11	£12 to £9
1888 ..	£22 to £18	£19 to £16	£17 to £13	£12 to £10
1889 ..	£26	£24	£21	£13 to £14

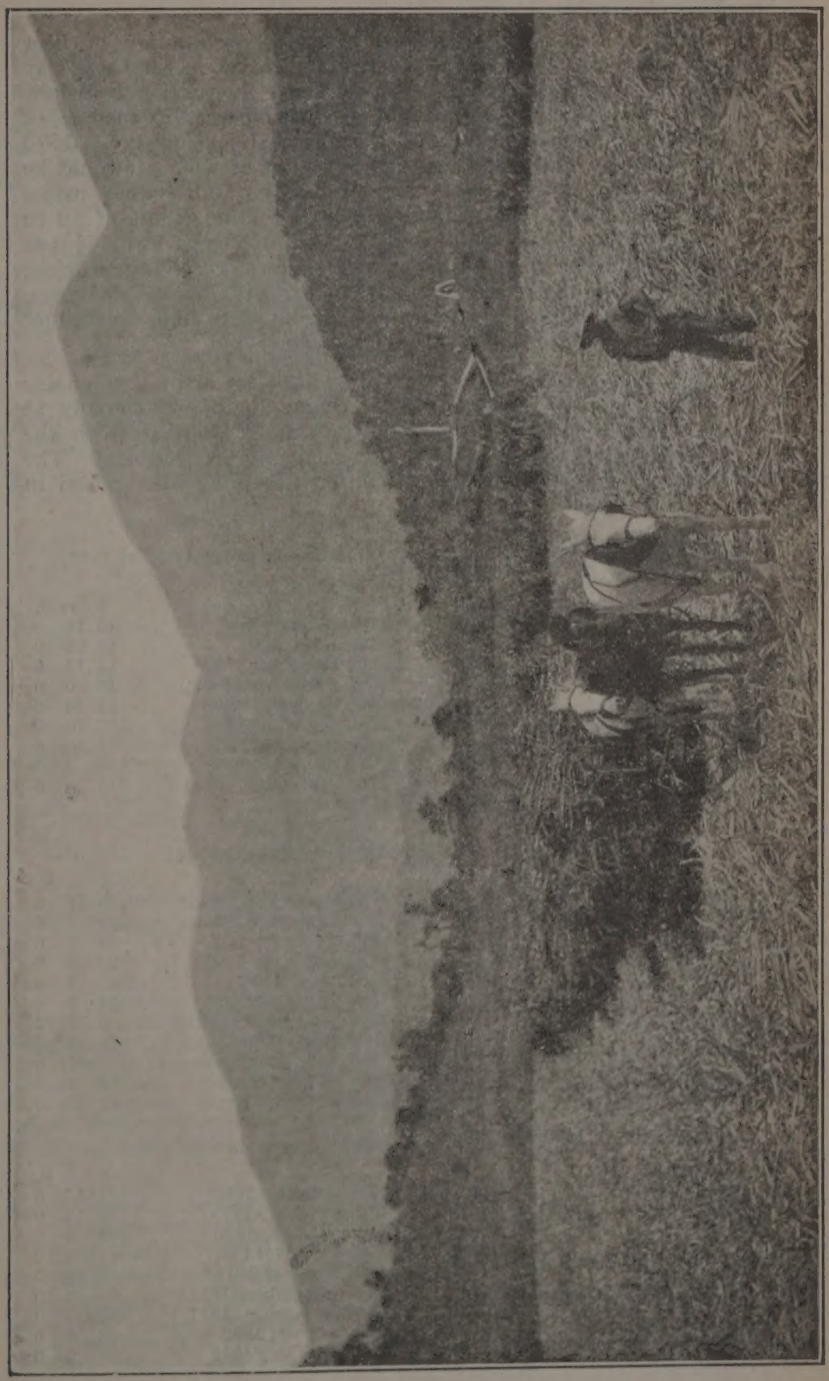

Plate 135.—Hauling Cane, Babinda, North Queensland.

Mr. Forrest went on to say—

> "Over-production, largely due to the production of beet sugar, which had affected the Australian market in the same way as all other markets, accounts for the above fluctuation in prices. In 1887 the estimated Queensland production was 57,960 tons, of which 41,890 were exported, leaving for local consumption 16,070 tons. The price of sugar was fixed by that at which it could be imported from other places. The Melbourne and Sydney prices ruled the market. Queensland benefited to the extent of £2 to £3 per ton on sugar sold locally. Agent charges were 6¼ per cent. That covered commission, *del credere*, receiving, storing, delivering and insurance—everything except freight, wharfage, and interest. Both insurance and freights were high; insurance rates should have been reduced long ago."

There is a gap between 1889 and 1893 which I am at present unable to fill up. The manager of the Colonial Sugar Refining Company at Brisbane has kindly supplied the following table from 1893 to the present date, of the prices of refined sugar current at Brisbane. The Brisbane office of the Colonial Sugar Refining Company was opened in 1893:—

PRICE OF NO. 1A REFINED SUGAR CURRENT AT BRISBANE FROM AUGUST, 1893, TO JUNE, 1931.

	£	s.	d.		£	s.	d.
17th August, 1893 ..	18	10	0	14th August, 1897 ..	15	10	0
12th March, 1894 ..	18	10	0	1st July, 1898 ..	14	10	0
16th July, 1894	18	0	0	7th December, 1898 ..	14	10	0
19th October, 1894 ..	17	10	0	13th December, 1899 ..	15	0	0
6th December, 1894 ..	16	10	0	24th January, 1900 ..	15	10	0
19th February, 1896 ..	17	10	0	22nd March, 1900 ..	16	10	0
11th July, 1896	16	10	0	10th May, 1900	17	10	0
26th September, 1896 ..	16	0	0	22nd August, 1900 ..	16	0	0
9th February, 1897 ..	17	0	0	23rd November, 1900 ..	16	0	0
21st June, 1897	17	0	0				

FEDERAL TARIFF ON SUGAR IMPOSED 8TH OCTOBER, 1901.

	£	s.	d.		£	s.	d.
9th October, 1901 ..	21	5	0	11th November, 1904 ..	20	17	6
24th October, 1901 ..	21	5	0	2nd December, 1904 ..	21	7	6
8th November, 1901 ..	20	15	0	6th January, 1905 ..	22	7	6
1st July, 1902	19	15	0	26th January, 1905 ..	23	7	6
8th October, 1902 ..	19	5	0	23rd May, 1905	22	7	6
17th November, 1902 ..	19	15	0	13th July, 1905	21	7	6
9th December, 1902 ..	20	5	0	2nd November, 1905 ..	20	17	6
7th February, 1903 ..	20	10	0	19th May, 1906	20	17	6
21st October, 1903 ..	20	0	0	3rd July, 1906	19	17	6
30th June, 1904	19	12	6	30th August, 1906 ..	19	7	6
20th September, 1904 ..	20	7	6	20th June, 1907	19	12	6

EXCISE ON SUGAR WAS RAISED TO £4 PER TON ON THE 1907 CROP.

	£	s.	d.		£	s.	d.
9th August, 1907 ..	19	12	6	1st October, 1910 ..	21	15	0
17th October, 1907 ..	19	12	6	13th October, 1910 ..	20	15	0
20th March, 1908 ..	20	2	6	31st October, 1910 ..	20	5	0
16th April, 1908	20	12	6	28th July, 1911	21	5	0
13th May, 1909	20	17	6	11th August, 1911 ..	22	5	0
2nd October, 1909 ..	21	2	6	1st September, 1911 ..	23	5	0
19th November, 1909 ..	21	10	0	3rd November, 1911 ..	23	15	0
5th January, 1910 ..	21	15	0	31st August, 1912 ..	23	5	0
25th February, 1910 ..	22	5	0	5th October, 1912 ..	22	5	0
8th March, 1910 ..	22	15	0				

Excise and Bounty, abolished 25th July, 1913.

	£	s.	d.		£	s.	d.
25th July, 1913	21	15	0	26th March, 1920 ..	49	0	0
2nd July, 1914	21	5	0	27th May, 1920	49	0	0
6th July, 1914	20	15	0	1st October, 1921 ..	49	0	0
24th October, 1914 ..	22	0	0	1st November, 1922 ..	42	0	0
18th February, 1915 ..	23	0	0	22nd October, 1923 ..	37	11	4
20th July, 1915	25	10	0	1st September, 1925 ..	37	6	8
17th January, 1916 ..	29	5	0	2nd July, 1928	37	6	8
18th November, 1918 ..	29	5	0				

The latter price is still current.

The above prices refer to refined sugar. Regarding the price of raw sugar I am unable to go further back than 1895. Prior to that, most of the mills turned out a white sugar direct for the market. According to the late Mr. John Drysdale, the average price received for raw sugar from 1895 to 1900 was £9 16s. 4d. per ton.

Commencing with 1901 the prices of raw sugars were close to the following figures. From 1901 to 1904, the payment was for raw sugar of 88 net titre; from 1904 on the net titre was 94. Prices for raw sugar varied a little in the earlier years according to the quality of the raws:—

Raw Sugar Prices, Queensland, 1901 to 1930.

Year.	£	s.	d.	Year.	£	s.	d.
1901	10	19	0	†1916	18	0	0
1902	11	2	10	1917	21	0	0
1903	11	3	3	1918	21	0	0
1904	12	10	11	1919	21	0	0
1905	12	2	8	1920	30	6	8
1906	10	14	8	1921	30	6	8
1907	10	9	0	1922	30	6	8
1908	11	3	5	1923	27	0	0
1909	12	2	6	1924	26	0	0
1910	11	7	7	1925	19	10	7
1911	13	8	6	1926	24	10	10
1912	12	17	2	1927	22	0	4
*1913	15	17	6	1928	20	17	11
1914	14	15	6	1929	20	5	10
1915	18	0	0	1930	19	13	1

After the outbreak of the European War in 1914 the sugar industry passed through a critical period. This will be dealt with in the next article.

[to be continued.]

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* The Excise and Bounty were abolished in 1913. Provision was made by "*The Sugar Growers Act of* 1913" of the Queensland Government for payment by the mills direct to the growers of what was really the old rate of bounty or rebate in the four different districts, plus the sum of 2s. 2d. The latter was assumed to be the sum returnable out of the £1 hitherto retained by the Federal Government, and was not fixed upon a sliding scale for the different sugar districts, as was the old bounty. The sums to be paid to the growers by the mills were, therefore—

	s.	d.
In No. 1 district	9	8
In No. 2 district	9	2
In No. 3 district	8	8
In No. 4 district	8	2

the old rates of bounty being 7s. 6d., 7s., 6s. 6d., and 6s. respectively.

This remained in force during 1913 and 1914, and was then suspended by an Agreement between the Federal and State authorities for the payment of £18 per ton of sugar in 1915.

† Cane Prices Board commenced operations.

Bureau of Sugar Experiment Stations.

CANE GRUB—BIOLOGICAL CONTROL.

J.M.R.

In connection with the recent cable announcing that an army of Canadian flies was speeding across Canada en route to Australia, where a battle against the sugar-cane grub on the plantations of Queensland would be staged, the Director of Sugar Experiment Stations (Mr. H. T. Easterby) has made the following statement:—

Some time ago the entomologist at the Bundaberg Sugar Experiment Station (Mr. R. W. Mungomery) applied for permission from the Federal Government to import a shipment of 500 white grubs parasitised by a fly known as *Microphthalma michiganensis*. These arrived last year and were imported in the hope that they might prove a factor in bringing under more effective biological control one or more of the most important scarabæids, namely—*Pseudoholophylla furfuracea*, *Ledipiota trichosterna*, and *Lepidiota frenchi*. Unfortunately, the mortality in this importation was high; only about 20 per cent. of the parasitised grubs surviving the journey, so that there were not sufficient to secure mating and subsequent larviposition, and the colony died out. This year it was determined to import a much larger quantity, with the help of the Canadian Government Entomologists.

The principle of controlling an insect pest by means of its insect enemies has worked with wonderful success in the Hawaiian Islands, where most of the previously important crop pests have been relegated to inferior positions. In Hawaii and California, where most of the pioneering work in biological control was carried out, success after success has followed these earliest parasite importations, and this has tended to popularise this form of control. More recently in Fiji, the Levuana moth, which, in 1925, threatened with extinction the coconut plantations there, has now been controlled in a most spectacular manner by a parasite introduced from the Federated Malay States.

In Southern Queensland, the cane grub has for many years been the most important pest of sugar-cane, and in some districts still requires certain control measures to be regularly instituted against it. The most important means of overcoming this pest is by a system of hand-picking the grubs and by soil fumigation. With the object of eliminating these tedious operations, and placing the pest under a more effective and satisfactory control, these Tachinid flies are being imported into Queensland from Canada. These flies in their native country attack root-eating grubs very closely related to our species, and it is considered likely that they will establish themselves on our species, in which case the cane grub may be reduced to the status of a minor pest. Whether, however, the fly will parasitise the Queensland species or not, will only be determined by actual experiment. Under these circumstances, therefore, it is unwise, at this juncture, to attach too much importance to the importation of these Canadian fly parasites, as there can be no guarantee that the insects will prove successful. Various factors such as the alteration of seasons from the Northern to the Southern hemispheres, the substitution of a new insect host, &c., have to be overcome, and finally, climatic conditions will largely govern the question of whether or not the parasite is likely to succeed. On this account, it cannot be emphasised too greatly, that there should be no cessation of control measures which have been carried on against the grub pest up to the present, until the success of an introduced parasite has been assured.

If you like this issue of the Journal, kindly bring it under the notice of a neighbour who is not already a subscriber. To the man on the land it is free. All that he is asked to do is to complete the Order Form on another page and send it to the Under Secretary, Department of Agriculture and Stock, together with a shilling postal note, or its value in postage stamps, to cover postage for twelve months.

THE LARGER HORNED CITRUS BUG

(*Biprorulus bibax* Breddin).

J.M.R.

By W. A. T. SUMMERVILLE, B.Sc., Entomological Branch.

THE Larger Horned Citrus Bug has been known to entomologists of this State (as a citrus-feeding insect) for more than forty years, but until about five years ago it was regarded as being of only minor importance from the economic point of view.

At various times during the last ten or more years, it has been reported as causing rather severe losses of fruit, but from the records it appears that the earlier outbreaks in pest proportions occurred in isolated cases, were of short duration and were infrequent. The only point of much interest gathered from these records is that the damage seems to have taken place at times when the particular locality affected was suffering from the effects of dry weather.

Thus very little attention was paid to the insect almost to the time when the investigation now recorded was commenced in 1929. This investigation was undertaken at that time following representations made by citrus growers in the Gayndah district. From evidence now gathered it appears, that with the development of the citrus-growing industry in districts, such as Gayndah, further removed from the coast than the main centres of citriculture had been situated previously, the insect has asserted itself more and more each year, until now it is undoubtedly the worst pest of citrus in these drier localities. At the same time there is very little doubt that for many years the insect has been responsible for heavy losses of fruit on individual orchards, both near and remote from the coast.

That it has become so important a pest, before attention was paid to it, in spite of these heavy losses, is due mainly to the fact that until recently it has not been possible to have an officer of the Entomological Branch keeping in constant touch with the general pest position of citrus, and that growers in general did not recognise the real cause of their losses and thus did not direct attention to it. The dropping of the fruit for which the bug was almost certainly responsible was, for the most part, attributed to climatic influences, and many growers were satisfied, apparently, that the loss was inevitable under the conditions in which they had to grow the trees at that time. The reason for this failure to identify the true cause of the falling of the fruit will be more apparent later, and it will be seen that this is by no means as unreasonable as might at first appear.

Of course there were some growers who knew, or at least suspected, that the bug was the agent of destruction; but, as has been stated, it is only comparatively recently that attention has been directed to the pest.

Synonomy.

The first reference to the insect was made by Tryon who, in 1889, described the adult fully, but did not give it any specific name. This reference appears in Tryon's "Report on Insect and Fungus Pests, No. 1" and the insect is there designated *Rhynchocoris* sp.

Ten years later W. W. Froggatt, following Tryon's name, referred to the bug in his "Insect and Fungus Diseases of Fruit Trees."

In the following year Breddin described the insect and named it *Biprorulus bibax* (Ent. Nachr, XXVI. 30, 1900).

In 1905, E. P. Van Duzee gave a very good description of the species, in the "Bulletin of the American Museum of Natural History" (Volume XXI.), in connection with his notes on Australian Pentatomidæ. However, in that work the generic name was wrongly given as *Birorulus*, an error which has since been repeated by other writers, but which was definitely corrected by G. W. Kirkaldy in the "Catalogue of the Hemiptera (Heteroptera) Volume I."

It may be noted in connection with Van Duzee's description mentioned above that, though very good in all other particulars, this is not accurate as regards colours, no doubt owing to the description having been made from old museum specimens.

Vernacular Name.

The vernacular name now proposed is admittedly rather cumbersome, but owing to the occurrence of a number of other somewhat similar insects on the same host plant, it is necessary to adopt a name which will distinguish it from these.

The older names—Green bug and Spiny Orange bug—have been discarded as unsuitable for the following reasons:—

(1) There are three green-coloured bugs commonly found on citrus in this State.

(2) Two of these green species are "spiny."

(3) *Biprorulus bibax* markedly prefers both lemons and mandarins to oranges.

To ensure then that growers will be able to definitely distinguish this bug from other similar ones feeding on the same host, it is necessary to use the somewhat long title of Larger Horned Citrus Bug.

Distribution.

From the available records this appears to be the only known species of the genus *Biprorulus*. It is confined to Australia.

W. W. Froggatt has recorded it from Gosford and other parts of the Hawkesbury River district, Moree, Coonamble, and Garah in New South Wales. In the collection of the Queensland Department of Agriculture and Stock there are specimens from many parts of the State, and it is known to occur as far north as Charters Towers and as far west as Roma in the southern portion of the State, and Barcaldine in the Central West. Probably it extends further west still.

The known distribution then is between latitudes 20 deg. S. and 34 deg. S. and from the coast west to longitude 145 deg.

Economic Importance.

As has been stated *B. bibax* has only recently come to be regarded as a major pest of citrus, and though it has probably been causing severe losses in more or less isolated cases for more than ten years, the amount of damage done has apparently grown with the development of the citrus industry, especially in places where the annual rainfall is 30 inches or less. For the most part these localities are situated more than 80 miles from the coast, but in others, such as the Rockhampton

and Caboolture districts, which are very near the ocean, the topography of the surrounding country apparently exerts sufficient influence to compensate for the geographical position. Possibly in and near the tropics the proximity of the coast matters less.

In other districts such as the Howard-Burrum area and on the Blackall Range, the occurrence of the insect in pest numbers is more or less spasmodic and usually happens on individual orchards or more generally in very dry times.

In assessing the importance of the pest it has to be remembered that the heaviest damage, and this is very considerable, is perpetrated in those districts in which the expansion of the citrus-producing industry of the State can be expected most confidently.

The lemon is the most heavily attacked species of citrus, and it is possible that the production of that fruit will become more and more important in those districts in which the bug operates most extensively.

Further, the class of fruit produced in these drier areas is for the most part very well fitted for export and is thus again of added importance.

In those districts near the coast, where the pest is less frequently troublesome, it has to be borne in mind that the losses for the most part occur in the very dry seasons, and, therefore, at a time when growers can, for the most part, least afford to suffer loss.

As regards the actual amount of damage which is occasioned, this varies, not only with the district, but even when the infestations on the same orchards are comparable in different years the loss seems to vary in quantity.

Losses of up to 90 per cent. of lemons have been experienced, but with moderate infestations 40 per cent. is the average.

Losses of 33 per cent. of all attacked varieties have been known in quite a number of cases, but for an average orchard in which hand-picking is practised fairly systematically 15 per cent. to 20 per cent. would, it is thought, be about the normal.

Unchecked, of course, there is almost no limit to the injury the pest will do, and in spite of diligent daily handpicking instances of approximately 30 per cent. loss have been noted.

Economic Host Plants and Varietal Preference.

The Larger Horned Citrus Bug has not been found to feed on any economic plant other than citrus. As far as citrus is concerned it attacks every variety grown commercially in the State. However, marked preference for certain varieties over others is evidenced.

The exact order of preference is not at all clearly defined in respect to the first two or three places, and in the course of observations on this point a number of apparently conflicting facts were noted.

In the great majority of cases the lemons are most heavily attacked. On the other hand on other orchards the Beauty of Glen Retreat mandarins are much more favoured than the lemons or any other variety. This preference for Glen Retreat over all other varieties of mandarins has been observed in a large number of cases. At times, however, the Emperor of Canton mandarin suffers more severe attack

than the Glens, whilst in a limited number of cases Fewtrell Early mandarins are more favoured than Emperors growing close to them.

Often it will be found that the bug will concentrate on one or other of these three varieties to the exclusion of all others.

Experiments have been carried out with a view to ascertaining the order of preference. The apparatus was very crude consisting essentially of three well-made boxes joined together by tubes of celluloid 3 feet long. An equal amount of light was arranged for each of the three boxes and the whole placed in such a position that draughts were reduced to a minimum. Adult bugs were placed in the centre box and fruits of different varieties in each of the others. Each experiment was repeated six times, the positions of the varieties being changed from end to end at the commencement of each trial.

It was found that lemons and Glen Retreats gave satisfactorily consistent results of attracting the insects away from all other tested varieties. Fewtrell Early showed very little capacity for attracting the insects.

The tests of the relative attractiveness of lemons and Glens were not satisfactory.

It was indicated that when both fruit were fresh the bug appeared to be well satisfied with either. When the mandarins were picked for some days before being supplied, the bugs for the most part preferred the lemons. The age of the lemons, however, did not appear to be material. These results were merely indicated and not definite. Consistent results could not be obtained.

The condition of the tree as regards quantity, and to a less extent quality of fruit, and more particularly as regards amount of foliage exerts a good deal of influence. The state of the fruit as regards maturity also is of importance, but none of these points explain the apparently inconsistent facts recorded above in connection with field observations.

Probably the most important factor, and one which has sometimes been fairly conclusively shown to account for apparent varietal preference, is the position of the other varieties relative to the lemon trees. The absolute position of some trees is also of account in determining just which variety will be most heavily attacked. This statement will be elaborated in the discussion on migration.

On all the evidence which has been gathered, it may be safely assumed that for all practical purposes the order of varietal preference may be stated as follows:—

1. Lemons. No preference with respect to commercial varieties, but the rough skin or bush lemon, as it is termed, is at times more heavily attacked than lemons of other varieties growing nearby in the same orchard. The loss of Villa Franca fruit is probably heavier than is the case with Lisbons owing to the fact that the former carries fruit rather more consistently throughout the year than the latter. 2. Beauty of Glen Retreat mandarins. 3. Emperor of Canton mandarins. 4. Fewtrell Early mandarins. 5. Scarlet mandarins. 6. Late Valencia oranges. 7. King of Siam mandarins. 8. Naval oranges. 9. Other varieties.

The Kumquat is also very palatable to the bug, but these trees are rarely grown commercially and the number to be found is comparatively small.

Fig. 1.

Fig. 2.

PLATE 136.

Fig. 1.—Small tree of Native Kumquat.

Fig. 2.—Small trees of Native Kumquat in foreground.

Other Host Plants.

In addition to the cultivated varieties of citrus *B. bibax* feeds and breeds on the indigenous plant *Eremocitrus glauca*—the native kumquat, or desert lime, as it is sometimes called. This plant grows in large quantities in the drier areas of the State and also in New South Wales. It is usually to be found in fairly open country and frequently occurs as an undergrowth in Iron Bark or Box formations.

W. W. Froggatt first recorded the insect from this host in New South Wales, but for a long time, in spite of diligent search by several officers of the Queensland Department of Agriculture and Stock, the bug was not found on the native kumquat in this State. However, it was finally found in large numbers on trees which had previously been examined. The trees were fruiting when the insects were found, whereas on each of the three previous occasions no fruit was seen. Since then the bug has been found on this plant, when in fruit, in several localities.

At Roma, where there are many acres of the native kumquat, the bug has been taken in the summer months on it. The plants were then carrying fruit. Exhaustive examination of the same plants in the winter was made, but not a single bug was found. In the following summer these plants again harboured the bug.

It would thus appear that *B. bibax* spends only a portion of the year on *E. glauca*. That means that there must be another host to which the insect migrates, at least during the winter months or possibly during most of the time the native kumquat is without fruit.

This other host cannot be represented by the orchard trees for in that case the migration would not be so complete, and further, as the insect is an indigenous one, this other host would appear to be necessarily an indigenous plant.

Again there is no evidence that the bugs migrate into the orchards between April and September. Indeed, the number of bugs found in the orchards during this intervening period is surprisingly small.

The native kumquat, as has been stated, grows for the most part on open country, and in general in the places in which it has been found, during these investigations, would certainly experience a fairly severe winter.

From the known fact that the insect generally thrives best in a hot, dry climate, it is reasonable to suppose that by passing the winter on the native kumquat it would be subject to very uncongenial conditions.

In addition to the native kumquat *B. bibax* has also been found on the finger lime—*Citrus australasica*. The bugs, in the adult stage only, were found on this plant in fairly large numbers during October. It may, therefore, be that this plant is the alternative host.

That would mean that the bugs habitually migrate from *E. glauca* to *C. australasica* at the beginning of the winter, and then return to the first-named plant with the advent of the warmer weather. This migration would coincide more or less with the periods of fruit bearing of each of the species.

PLATE 137.
Leaves and fruit of Native Kumquat. The fruit is often much larger than these illustrated.

C. australasica is confined to the heavy coastal scrubs such as are found on Tamborine Mountain and the Blackall Range. There is another indigenous species of citrus (*C. australis*) which is found somewhat further inland than the finger lime, and it is probable that *B. bibax* also feeds on this.

If either *C. australis* or *C. australasica* is actually the alternative host plant to *E. glauca*, it would mean that bugs for the greater part would have to travel very long distances between reasonably large supplies of food plants. The distance, however, is by no means so great as to preclude this possibility, and this may easily be the true explanation.

There is, however, the further possibility that there is still another host plant which grows further inland than *C. australis*.

It would be expected that this alternative host is a Rutaceous or allied plant, which probably grows in a closer formation forest or scrub where the bug would be able to spend the colder months less exposed to the rigours of the weather than if it were to remain on the kumquat.

Some time has been spent searching for this additional host, but so far it has not been found.

Descriptions.

The following descriptions are essentially rather technically worded. This is necessary in order to avoid undue length. However, if these descriptions are read in conjunction with the plates prepared by Mr. Helmsing, there should be little difficulty in identifying any of the stages of the insect.

In connection with the notes on colour it may be pointed out that, though there are many variations to the rule, it appears that, on the whole, bugs developing during the cooler times are rather darker in tone than those maturing in the warmer months. Further, it has been noted that mid-summer bugs are lighter in colour than those to be found either just earlier or slightly later. These remarks, of course, refer to depth of colour only and not to actual colours.

The bugs selected for Mr. Helmsing to work from were late-summer ones and were about average specimens.

Plate 139 (Figs. 1, 2).—Egg.

Diameter, 1 mm.

Almost globular, but slightly higher than wide. Glistening white (pearly). Surface covered with extremely fine punctations irregular in placings. Rim of operculum fringed with about twenty minute capitate hairs (chorionic processes).

Plate 138 (Fig. 2).—First Instar.

Length, 1.5 – 2 mm. Almost as broad as long.

Practically oval evenly rounded posteriorly and rather pointed at head. Convex dorsally and abdomen biconcave ventrally. Abdomen dorsally orange, except first segment, which is practically colourless. On venter, abdomen is pale green, becoming orange towards the margins. Sides of abdomen black on both surfaces. Dorsal surface of abdomen marked with five black transverse stripes; anterior one narrow, second wide, third widest, while the fourth and fifth are very small and in some cases merely dots. Head and thorax black, except median region of thorax ventrally which is pale green. Legs long, brown in colour. The tibiæ and tarsi with short light-brown hairs. Antennæ brown to almost black, except bases of ultimate and penultimate joints, which are orange in most cases. Rostrum short and stout reaching to third abdomenal segment, pale green in colour.

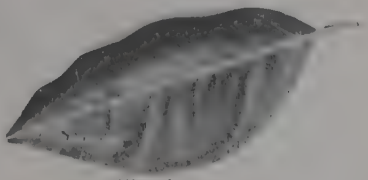

Fig. 1.

Fig. 2.

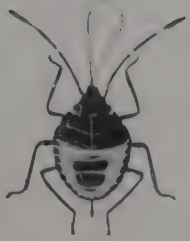

Fig. 3.

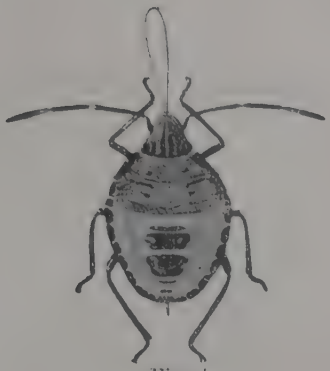

Fig. 4.

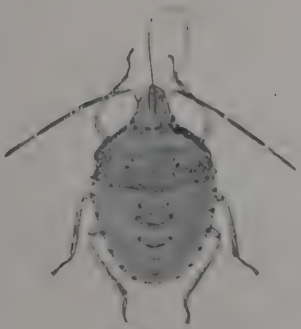

Fig. 5.

Fig. 6.

PLATE 138.

The Larger Horned Citrus Bug (*Biprorulus bibax* Breddin).

Fig. 1.—Eggs on leaf; half natural size; Fig. 2.—First instar × 4; Fig. 3.—Second instar × 4; Fig. 4.—Third instar × 4; Fig. 5.—Fourth instar × 3; Fig. 6.—Fifth instar × 3.

—From a water-colour drawing by I. W. Helmsing.

PLATE 138 (Fig. 3).—SECOND INSTAR.

Length, 4 – 5 mm. Breadth, 3 – 4 mm.

General shape and colouration as in first instar, but ventral surface of head and abdomen becoming pale green. Coxæ and trochanters pale green. Rostrum almost 1 mm. longer than body and held projecting beyond the end of the abdomen. The rostrum is also pale green, and the stylet is invariably held half exerted and erect in front of the head. It is brown and very conspicuous as carried. Antennæ dark brown, except the extreme base of penultimate and basal half to one-third of ultimate joints which are orange. Femora sparsely and tibiæ and tarsi hirsute. The transverse lines on abdomen are as in stage I., except that the second and third are broader and the fifth smaller than in that stage.

PLATE 138 (Fig. 4).—THIRD INSTAR.

Length, 7 – 9 mm. Breadth, 4 – 6 mm.

In this stage there is a great amount of variation in the colours of different individuals. There does not appear to be any connection between the colouration and the subsequent development of the individual. Though usually the insects are assignable to a light or a dark variety, there are often many intermediate forms. Generally speaking, it has been noted that the lighter individuals are larger than the darker.

In both varieties the venter is pale green, except at the margins which are black. The ground colour of the dorsum is also green. The five black transverse lines are still represented. The anterior three are more pronounced than in the preceding stages, while the posterior two are less conspicuous or even absent. The second and third are now much wider than formerly, and are really a series of spots and blotches rather than a simple line as previously. Antennæ dark brown to black, except the base of the ultimate joint which is yellow. Thoracic margins are now flattened to form a narrow flange which varies from mottled green to black. In the median region of the head are two parallel lines which are brown to black and run the length of the head, traversing grooves from the base of the proboscis for about two-thirds their length. In the darkest individuals these lines are not distinguishable as such. Rostrum reaching at least to base of abdomen and usually projecting beyond the extremity. Stylet carried as in stage II.

The colouration of the remaining parts in light specimens is as follows:—Head and thorax light green, lightly mottled with black; the black being confined to irregularly placed punctations. Yellow portion of the antennæ very conspicuous. Coxæ trochanters and femora light green; tibiæ and tarsi brown.

Dark specimens differ in that the mottling of the head and thorax is much more pronounced and in extreme cases, which are common, the whole head and thorax is uniformally black and shining. On the abdomen the dark portions are again more pronounced and the femora are green at the base only, the remainder being dark brown to black.

PLATE 138 (Fig. 5).—FOURTH INSTAR.

Length, 9.5 – 11 mm. Breadth, 6 – 6.75 mm.

Dorsum.—Pale green. Head and thorax mottled with black; abdomen less thickly so. The degree of mottling varies, some individuals appearing uniformally green, while in others the head and thorax appear quite black. On the abdomen the dots are arranged more or less in transverse lines, elsewhere the placing is less regular. The black is practically confined to punctations. The thorax is mottled more heavily towards the margins. There is a black spot on each side of the mesothorax one-third way from the median line towards the anterior, and usually another such spot on the posterior edge of the metathorax. The longtitudinal lines of the head conspicuous. Antennæ with basal joint green suffused with brown, remainder brown, except the basal half of last joint which is orange, sometimes with a small green area.

The lateral margins are brown to black, narrow on head, wider on thorax, and very variable on abdomen. Here it may be merely a line on the margin widening to a spot at the posterior angle, or it may be widened out at both angles or evenly wide over the whole length. Other abdominal markings are also variable. At least there are four black spots, more often six, forming a square or rectangle. The posterior four mark the position of glandular openings from which a secretion is emitted. The area about these glands is somewhat elevated. In darker specimens these areas are so thickly mottled as to appear quite black.

Venter.—Lighter green than dorsum, with lateral edges brown to black. The green is very lightly mottled with black. The lateral band varies as on dorsum. Proboscis light green, with tip black and reaching almost to tip of abdomen. Stylet

Fig. 1.

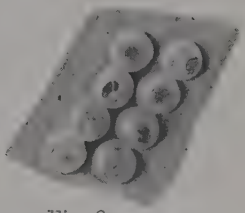

Fig. 2.

Fig. 3.

Fig. 4.

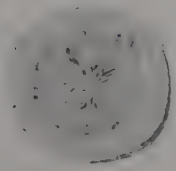

Fig. 5.

Fig. 6.

PLATE 139.

The Larger Horned Citrus Bug (*Biprorulus bibax* Breddin).

Fig. 1—Eggs about to hatch × 4½; Fig. 2—Eggs parasitised × 4½; Fig. 3—Adult ventral view × 1½; Fig. 4—Adult dorsal view × 1½; Fig. 5—Orange showing damage, one-half natural size; Fig. 6—Lemon showing damage, one-half natural size.

—From a water-colour drawing by I. W. Helmsing.

brown, held partly exerted. Tibiæ green suffused with brown, tarsi with first joint green to brown, second joint brown, remainder of legs green. Femora sparsely tibiæ and tarsi rather thickly hispid.

PLATE 138 (Fig. 6).—FIFTH INSTAR.

Length, 13 – 16 mm. Breadth, 8.5 – 9.5 mm.

Dorsum.—Green mottled with black dots, the black again confined to depressions which are larger on the thorax than on the head and abdomen. The punctations at times confluent and on abdomen are arranged more or less in lines. The entire lateral margins of the sclerites black; this black portion widening out, at least at the angles, but sometimes uniformally wide for whole length of abdomen. Eyes dark-brown with a narrow band of very pale green: ocelli marked by red spots. Proboscis light green with tip black; stylet brown held as in stage IV. Head with black dots on posterior margin close to median. Antennæ brownish black to black, except the basal half of ultimate and penultimate joints which are orange. Sometimes the whole of ultimate joint yellowed; last three joints pubescent. Prothorax with the flange black, sometimes with a light green stripe towards the margin. Scutellum with five black spots, four on the anterior margin and one on the apex. This last spot sometimes absent. In addition, on the scutellum there is often a faint black transverse line on each side near the anterior margin. Wing pads well developed; generally thickly mottled with black towards the tips. Pronotum somewhat expanded sideways, but not wider than the greatest width of the abdomen. The three raised areas about glands conspicuous with black lines, or in lighter specimens black lines represented by about six spots.

Venter.—Lighter green than dorsum. Abdomen usually with very fine brown spots. Legs green becoming darker towards the tarsi, which are shining brown to black. Femora, tibiæ and tarsi hispid; in darker individuals the tibiæ may be dark brown also.

PLATE 139 Fig. 4).—ADULT.

Length, 14.4 – 22 mm. Breadth, 12 – 16.5 mm.

Elongate oval. General colour shining lemon-green, somewhat lighter on the venter than dorsum. Head elongate slightly tapering to front, punctate above, somewhat striate transversally beneath. Eyes black with a posterior band of very pale green. Ocelli brown set close behind the eyes. Antennæ green, last four joints pubescent, ultimate joint rather more lightly so than rest. First joint shorter than head, second longer than first; third joint about twice the length of second and about equal to fourth; fifth a little more than half the length of fourth.

Pronotum strongly declined anteriorly, deeply emarginate. Pronotal angles strongly produced at sides forming stout very sharp spines. These spines appear black, but actually are black in front and at tips, but blue behind. Scutellum triangular with sides curved inwards, bluntly rounded posteriorly more than half as long as abdomen. Pronotum and scutellum coarsely and closely rugose, except for a smooth area on each side near anterior margin of pronotum occupying half to two-thirds total width.

Forewings extending a little beyond end of abdomen; corium less coarsely punctate than scutellum.

Posterior angles of each abdomen segment black produced in small sharp spines.

Rostrum green with black tip; in full fed specimens not extending beyond the fourth abdominal segment.

Carina extending to base of head, deep, split at posterior end. Ventral spine short and stout received into split in the carina.

Spiracles conspicuous very pale green.

Ostiole prominent. Ostiolar canal evanescent.

Prosternum coarsely and venteral surface of abdomen finely punctate.

Meso and metasternum with ill-defined striæ.

Femora tibiæ and tarsi pubescent; tarsi brown, rest of legs green.

Sex Differences.—Apart from primary sex differences which are clearly marked the following secondary sex characters may be noted:—

As a rule the female is larger than the male. The abdominal spines of the last segment of the female are strongly developed and sharply pointed, while in the male these are scarcely produced into spines but are rounded and set wider apart than in the female. The posterior margin of the last segment in the male is clothed with fairly stout hairs, while in the female the hairs are less numerous and confined to the area around the spines.

Proportion of Sexes.

Counts of large numbers of adults were made in various localities at each season of the year, and it was found in every case that males and females were present in about equal numbers.

In the laboratory it was noted that in general the male was rather shorter lived than the other sex.

As regards the hatching from individual batches of eggs, no constancy in proportion of sexes was found—sometimes one sex being in the majority and at other times the sexes were about equally represented.

Allied Citrus Insects.

Of the five bugs which are commonly found feeding on citrus in Queensland there is some superficial resemblance between the three green species—*Biprorulus bibax, Vitellus antemna* Breddin, and *Lyramorpha rosea*. Westw. Of these three the last-mentioned may be easily recognised by its large size, and more particularly by the "swallow tail" appearance. This species is, moreover, without any semblance of spines on the thorax.

The resemblance of the other two green species is much stronger, but *B. bibax* is larger, has more pronounced spines, and is devoid of the reddish markings which adorn the smaller insect. The immature stages of these two are somewhat similar but the sizes are again different.

The remaining two citrus-feeding bugs are so different from the Larger Horned one that confusion is very unlikely. One of these is bronze to black in colour and much larger, while the other is quite different in shape and is bluish-black with red markings on the legs and under surface.

Habits and Characteristics.

The eggs are to be found on all aerial portions of the tree except floral parts. Under natural conditions they have not been observed on any plant other than the now recorded hosts, as is often the case with the Bronze bug. The most favoured positions are the fruit and the leaves. The most frequently used site of all is on the upper surface of the leaves close to the mid rib. The eggs are affixed to the plant by a sticky secretion which covers them as described in the discussion on oviposition. They are deposited in batches of various groupings. The most commonly found grouping is two parallel rows of equal or nearly equal length. Single rows and a V-shaped arrangement are also frequently met with, while double-ended rows or irregular placings are also found.

When two eggs are laid together they touch each other, and when more than two are grouped they are usually touching one another on all possible sides.

As regards the numbers of eggs to be found in the batches, these vary considerably and the following counts of apparently normally laid batches were made in one orchard on the same day:—25, 24, 17, 28, 27, 30, 19, 16, 22, 24, 30, 28, 10, 15, 18, and 27.

As low as two or even one may sometimes be seen, but less than six is not common and it is probable that in most of these cases the female was disturbed whilst ovipositing. The greatest number of eggs found in one lot was 32.

PLATE 140.
The Larger Horned Citrus Bug (*Biprorulus bibax* Breddin).

On hatching from the eggs the young, unless molested, remain grouped together, generally close to the site of the egg shells from which they have emerged. In this stage they do not feed, their only requirement seemingly being water. In the laboratory it was found that these first instar bugs thrived best in an atmosphere kept moist, but they did not long survive, when free water was allowed to remain in the container, or in a dry atmosphere.

On moulting to the second stage the bugs usually scatter and soon begin to feed. From now on there is no inclination to congregate again whilst in the immature stages.

When the younger insects are disturbed they attempt to escape by running down the branches. When dislodged from the tree they soon begin crawling, and in by far the greatest number of instances they move directly towards the base of the tree from which they were removed. If the ground be clean they reach the base of the trunk in a surprisingly short time, but where weeds or other plants are growing they more often climb a stalk on the way. It may be mentioned that it is by no means easy to dislodge the later stage larvæ from the trees by tapping the limbs. This is due partly to their habit of running down the branches, for by so doing they get into positions in which the vibration resulting from the tapping is minimised.

With adults there is a certain amount of congregating. Generally speaking, the mature bugs are found in pairs—i.e., a male and a female—but frequently three or four bugs are closely associated, sometimes feeding on the same fruit. When three are found in a group it is usually two males and one female. As many as six adults are occasionally found on one fruit.

In the winter there is a certain amount of grouping together of the adults—sometimes clusters of a dozen or more being found in a thickly foliaged part of a tree. This is not, however, very common.

The adults are capable of flying strongly, and though no idea of how far they can fly without resting has been obtained, it has frequently been observed that bugs on the wing when followed at a sharp walking pace for over a hundred yards, have disappeared from view apparently flying as strongly as when they took off.

During the day, however, they do not fly unless molested, and even then they prefer to escape by crawling rather than by flying. This point is of importance when the question of fumigation is being considered. When on the wing they make a characteristic buzzing noise. Even on a cold winter morning, when the trees are dripping dew, they are capable of flying, though at this time their flight is sometimes more or less laboured.

Most of the flights are taken in the late afternoon after the sun has lost its strength and while there is still daylight. At this time they are to be seen flying about the orchards, generally only moving to a tree three or four removed from the one they have just left.

The insects prefer a thick, leafy tree to one of scanty foliage, and this is no doubt due to their objection to being exposed to excessive heat. Experiments were carried out with a view to determining the effect of light on the insects, and it was found that, in so far as light was concerned—i.e., white to yellowish rays—there was no reaction, either positive or negative, at any time early in the night or within

an hour of sunrise. However, it was noted that when the source of light was placed so close as to affect the insect by its heat, the bug at once crawled away far enough to avoid the high temperature.

Also it has been observed that when the sun becomes very hot the bugs either seek shelter under the twigs towards the centre of the tree or move round to the shaded side and resume feeding there.

In the winter, adults are most frequently found in the heavily foliaged trees, this probably being due to the fact that in such trees they are protected somewhat from the weather.

During the day both nymphs and adults are usually found in by far the greatest numbers on the fruits. This is no doubt partly because they are more easily seen there than when amongst the leaves. The colour of the adults particularly, and of the fourth and fifth nymphal stages, harmonise so well with that of the leaves and twigs that it is seldom possible to get an accurate idea of the number of bugs on a tree which is at all thickly foliaged. An example of how difficult it is to find the insect is provided by the following:—Three Emperor mandarin trees were examined on one occasion. These trees were moderately thickly foliaged and fifteen minutes was spent on each. Where necessary the tree was climbed. They were then fumigated and the bugs thus brought to the ground. The counts made were:—

Small tree: One bug observed, 10 more brought down by fumigation.

Medium tree: Three bugs observed, 35 more brought down by fumigation.

Large tree: Fourteen bugs observed, 62 more brought down by fumigation.

From this it can be seen that it is very difficult to find the insects in the orchard, and the failure of a large number of growers to connect the loss of their fruit with the bug can be more readily understood. The scarcity or rather apparent scarcity of the insect is very misleading. Of course, the above examination was carried out when there was very little fruit on the trees thus making the search more difficult.

Feeding has been observed at all hours from daylight to dark but, as has been mentioned above, during some of the hottest hours in mid-summer feeding is suspended by many bugs which prefer to rest in the shade until conditions become more congenial to them. Nocturnal feeding has not been observed, but it is suspected that feeding is carried on sometimes after nightfall.

The most active times seem to be between sunrise and about 8 a.m. and between 3 p.m. and sunset. It is at these times that it is best to carry out handpicking, for the bugs are then mostly on the outside of the tree and usually on the fruit. They can thus be seen more readily and captured with greater ease.

The insects prefer clean fruit to that infested by scale, but the presence of scab (*Sporotrichum citri*) does not appear to be distasteful to them.

Winter Feeding.

In view of the comparatively small number of bugs which are usually to be found in an orchard during the winter time, and the fact that positive proof of their feeding on citrus at that period of the year was not readily obtainable by observation, a small test was

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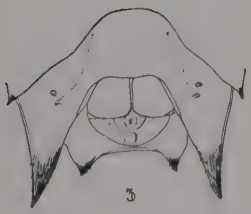

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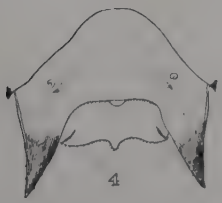

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I W Helmsing 1929

PLATE 141.

Fig. 1.—Ventral view anal segment of female of *Biprorulus bibax* Breddin.
Fig. 2.—Ventral view anal segment of male of *Biprorulus bibax* Breddin.
Fig. 3.—Ventral view anal segment of female of *Vitellus antemna* Breddin.
Fig. 4.—Ventral view anal segment of male of *Vitellus antemna* Breddin.

carried out concerning this. Twenty bugs were obtained and of these ten were placed in a cage in which grass only was growing. The other ten were enclosed in a similar cage containing a citrus tree without fruit. Within twenty-four hours four of the first lot were dead and the other six very sluggish. Three of the sluggish ones were transferred to a citrus tree. These last three recovered, whilst the other three died within forty-eight hours. All the control bugs—i.e., those originally put on citrus—were alive at the end of the experiment. It would appear then that feeding takes place in the winter time to a much greater extent than might reasonably be supposed from field observations.

Secretion.

The adults, and to a lesser extent the last two larval instar bugs, are able, apparently at will, to eject an evil-smelling secretion which stains the skin a bright yellow. On softer parts severe irritation may be caused; in extreme cases burning results. If lodged in the eye it causes acute pain and has been reported to result in temporary blindness. This secretion, which is an almost colourless liquid, is ejected from glandular openings situated on the dorsum. Apparently the liquid when in quantity is very distasteful to the insects themselves, for if enclosed in a container in which free secreting is in progress the mortality is very high. For this reason great care had to be taken when transporting adults from distant orchards to the laboratory. If the adults were allowed to crawl into the container in their own time and way they could be kept crowded for a week or more without incurring a loss of more than 1 per cent. If handled at all roughly they secreted freely and the mortality was high.

The secretion is, however, not nearly so objectionable as that of the Bronze bug (*R. sulciventris*) which on the slightest provocation will squirt its fluid a distance of 2 feet or more. No such long distance has been noted in the case of *Biprorulus*.

Mating and Oviposition.

After the insects have reached the adult stage they enter upon what might be termed a period of preparation.

In the case of a female, under laboratory conditions, this preparation extends over about a fortnight. The number of observations in the case of males is rather small, but it would appear that a similar period also must elapse with this sex between the time of reaching the adult stage and the time of commencement of reproductive activity.

Copulation is in the usual manner for bugs and has been observed to extend over nearly two hours in several cases.

The preliminaries to copulation consist essentially in the male walking round about the intended mate and stroking her with his antennae when opportunity offers. These preliminaries may last for hours at a time.

In the greatest number of observed cases the female has deposited fertile eggs within forty-eight hours of copulation and often the interval was less.

The greatest number of eggs laid by any female under artificial conditions was 199. This individual was rather abnormal, and it would seem that the average is somewhere about half that number. Table III. gives the details of ten females segregated for tests of oviposition.

In one case a female laid ninety-three eggs over a period of twenty-three days. The male with which she was mated died three days after oviposition commenced and was not replaced. She continued to lay fertile eggs—only six of the last batch of twenty-two failed to hatch.

The act of oviposition is interesting. When ready to lay, the female commences movements of her abdomen which are suggestive of strain. The first egg appears in a few seconds after the beginning of the movements, and from then on eggs are expelled at intervals varying from two to five or even six minutes.

As each egg appears it is seen to be covered with a fluid. This fluid is the material by which the egg is ultimately fixed to the host plant.

When the egg has been forced from the body it is pushed into position by the hindmost leg. Usually the eggs are arranged in two parallel rows set close together. In pushing the egg into its position the female uses the hindmost leg on the side remote from the row in which the egg is to be placed. The consequent movement of her body bring her into such a position that the next egg falls where it can be readily placed in the other row. Thus the rows are generally either equal or contain only one egg more or less than the other.

It is rarely that oviposition takes place between 9 a.m. and 5 p.m. Copulation, however, has been noted at all hours of the day and has also been seen at night.

Migration.

One of the most important and at the same time one of the most difficult habits to establish as fact is that of migration from one orchard to another, or more particularly from native host to orchards.

After collection of all the seemingly relevant facts it is concluded that migration from one orchard to another is in general of no practical importance, and, further, that migration from the native host to orchards does take place and is of the greatest possible importance.

The evidence on which this conclusion has been reached is as follows:—

1. The insect has been found to live and breed on indigenous plants.

2. *E. glauca* has been found growing in most of the heavily-infested districts and, though it has not been found in others, there is reason to believe that it does grow in them. From the ecology of the plant it could be expected to thrive in such localities. It has not been found near Gayndah, but the country round that place is in great part infested with dense prickly-pear and a thorough examination of the area is scarcely possible and certainly could not be carried out in the time available. The amount of country which can be even cursorily examined in a day is negligible, and the examiner as a general rule has to go where he can and not where he may wish. *Eremocitrus glauca* extends from Roma up through the Dawson Valley and back on to the coast at Raglan, between Gladstone and Rockhampton. No doubt it extends much further west, and it also is found in New South Wales.

Further, as has been stated earlier, there is some reason for thinking that this is not the only native host plant of the bug which grows in inland localities.

3. The bug can fly strongly and habitually does so.

4. At the outset of the investigation observant orchardists frequently stated that an infestation often appeared to commence suddenly with large numbers of adult bugs. This may have been due to the fact that the damage by the adults is much more severe than that by the younger bugs, or that the adults are more easily seen than the last two instars owing to the fact that the former are larger and that they are commonly seen flying in the orchards as described above. However, this point can be considered in conjunction with the next one.

5. In early December of 1929, at the time when the eggs which represent the commencement of the early summer generation were about to be deposited, an orchard was freed of bugs by fumigation. This experimental orchard was in an isolated position and the two nearest orchards were also fumigated at about the same time. These orchards were 1 and 3 miles distant respectively from the experimental one.

Very few eggs were found and these were destroyed at once. It is certain that the number of bugs left after the fumigation was very small. Daily examination of the orchard in question was carried out, and no bugs were seen until the last few days of the year.

At this time, according to the results of the life history study, a new generation is about to commence. The owner of the orchard in the first seven days of the new infestation collected by hand over 400 adult bugs. No immature stages of the pest was seen. The following week more than 300 eggs and some 200 first-stage bugs were collected. In one day the next week 420 eggs were found, but no bug older than a second instar was seen—i.e., except adults.

6. In the winter of 1929 two orchards were freed from the pest, one at Gayndah and one at Caboolture. Both of these orchards were kept under observation and both apparently remained free from bugs until late October.

7. In another instance an entire orchard was fumigated twice at an interval of about three weeks. This was done in the summer. The trees again remained, as far as could be discovered, free from bugs until about the middle of February. Soon after this the bugs were again in evidence though the infestation was light.

From 5, 6, and 7 it will be seen that an orchard having been cleaned of the bug can be kept in that condition for a limited period only and that reinfestation may occur as soon as the individuals of the generation mainly concerned have had sufficient time to reach the adult stage—i.e., when the bugs of the dominant brood are capable of flying.

8. In many instances it was noticed that the trees on one face of an orchard became infested much earlier than the remainder, and in some of these cases the bugs did not work into the orchard to any extent. This was soon shown to be independent of varietal preference.

In the case of the experimental orchard mentioned in paragraph 5, the lemon trees are planted in two rows on the western side of the orchard. On the eastern side are Glen Retreat mandarins and oranges for the most part.

The reinfestation of this orchard took place on the eastern face and it was some time before the bugs moved in past the third row of trees.

On another orchard in the same district the lemons are for the most part on the eastern face. In this instance an influx of bugs took place on the lemons and practically stayed there.

In neither of these instances could the bugs have come from another orchard within 15 miles, for all possible sources of infestation of this nature were fumigated and kept under observation. Not only was there no reduction of the numbers of bugs in the surrounding orchards, but in every case an influx took place as nearly as could be discovered at about the same time.

It is thus evident that the adults migrate to the orchards at the time of commencement of each generation.

There is no evidence to support the idea that the migration takes place from one orchard to the other.

Changing host plants is, of course, a very different thing to changing trees.

That there is some movement of bugs directly between orchards is probable, but it is thought that except in the districts in which the orchards are close together this is not important.

No case of sudden diminution of numbers of bugs in any orchard has come under notice, and in every case examined the number of adults found has been comparable to the number of fourth and fifth stage larvæ immediately before. Generally, of course, the adults are present in excess of what might be expected.

It is therefore concluded that the migration takes place between the native host plant and the orchard and not between orchard and orchard.

With respect to the intensity of each migration, the evidence collected points to the fact that the spring numbers are small, the early summer arrivals slightly greater or about the same. The mid-summer is a period of heavy infestations from outside, and the February arrivals are generally rather few in numbers.

Attraction to Lemons.

A further point concerning the characteristics and one which appears to have direct bearing on the migratory habit is the apparent attraction of the bugs to lemons. As far as could be discovered, there is no record of an orchard being heavily attacked by this insect, which did not have a number of lemon trees either in or adjacent to it. The bug has been seen in very small numbers on some lemon free orchards, but it has not been of economic importance on them. Further, in every case it has been found that there is a lemon tree within a few hundred yards of the place.

At Gayndah, Roma, and Rockhampton lemons are grown commercially and in large numbers, and in each of these three districts the insect is of great importance. Of course the climates of these three places are rather similar. Unfortunately, there is no commercial orchard which could be examined and which did not contain some lemon trees. However, at Orallo, 30 miles distance from Roma and with the same general climatic conditions operating, there is one orchard situated in an isolated position. Within half a mile of this grove are many acres of *Eremocitrus glauca*. The orchard contains no lemon tree, and, as far as could be discovered, there was no lemon tree close by it. The bug has so far not been seen on this place.

At Palmwoods, in which district the orchards are set fairly close together, the insect is generally unknown to growers, but every year it causes losses to the two growers known to have lemon trees. At Cooroy, further north, the same state of affairs exists.

At Howard and on the Blackall Range there are very few lemon trees to be found and the bug is very scarce as a general rule. In every case of economic damage brought to notice, it was found that a lemon tree was growing in close proximity.

It is thus indicated that the lemon is the main if not the only source of attraction which induces the bugs to leave the native hosts.

In connection with the habit of migration it was mentioned above that reinfestation after fumigation of the experimental orchard took place on the eastern face, whereas the lemons are all growing on the western. Further, the bugs remained on the eastern side for some time. Not only was this so, but the bugs did not cross to the lemons at any time in large numbers. The lemons are good, heavily-fruiting trees, but apparently the bugs were not greatly attracted to them. In a subsequent fumigation less than 1 per cent. of the bugs in the orchard were found on the lemons.

It would seem, then, the lemon supplies the attraction for the bug to leave its native host, but that once the insect arrives in the orchard it depends on the relative positions of other varieties just where the pest will operate most extensively. On the experimental orchard the wants of the insect are apparently fully satisfied by the Glen Retreat mandarins without any necessity of lemon fruits being obtained. Thus the lemons are almost free of the bugs.

On the other hand, one orchard has been mentioned in which the lemon trees are on the side on which the bugs arrive. By far the greatest damage on this orchard is done to the lemons. Apparently the bugs are here satisfied with the lemons, merely spreading to other favoured varieties by chance or force of circumstances. This is further borne out by the fact that in one part of this orchard a row of lemons runs through the place at right angles to the main lines. These lemons are for the most part affected later and more lightly and the mandarins in the next row to them have been found to harbour more than the average number of bugs for trees of the same variety in the same orchard.

There is, however, very little evidence that the Glen Retreat trees will attract the bugs from the lemons in any numbers sufficiently large to suggest that the latter is less attractive at close range.

On all the evidence it appears that the lemon is attractive over longer distances, but that there is little difference between it and the Glen Retreats at close range. Probably the state of the trees as regards amounts of fruit and foliage is of more moment than variety, in these circumstances.

Injury.

Feeding appears to be confined to the fruits if these be present. It has been shown experimentally that if no fruit be available the insects will feed to a limited extent on the young tender twig growth.

The proboscis is inserted through the rind and appears to just penetrate the pulp.

The insect, of course, feeds by suction. The effects following this differ somewhat according to the variety of fruit.

In the case of lemons less than an inch and a-half in length, the fruit quickly falls after showing premature yellowing. Larger lemons do not drop from the tree so quickly, but the same discolouring usually takes place. With lemons about 1½ to 2 inches in diameter, which is the size most favoured by the bugs, the yellowing is often confined to small areas around the point where the proboscis has been inserted. This size fruit and larger often remain on the tree for a long time after being attacked. At times the premature colouration does not take place to any appreciable extent. In such cases there is often no external characteristic by which an injured fruit can be distinguished with certainty, though often with these an area of the skin can be picked out which has a somewhat blistered appearance.

With oranges and mandarins the premature yellowing invariably takes place, and unless the fruit is well grown it falls from the tree almost immediately. Mandarins particularly fall very easily. Oranges, as has been stated, are not greatly favoured by the pest and except in the spring months it is unusual to find these fruits attacked after they have reached about 2 inches in diameter.

In the spring the late and second crop oranges hang very well after attack, but the yellowing appears to take place very quickly.

Even mandarins appear to hang better after they attain a size of about 2 inches in diameter.

The fact that a great deal less fruit falls after February than before or during that month is due, it is considered, to the fact that the wants of the bug can then be satisfied by less fruits, for these are then much more succulent and also hang better.

Internally the effect of the feeding varies. With all varieties, however, there is a certain amount of drying out of the tissues. In the most severe cases, especially with young lemons, the drying out may be practically complete, but usually the dryness is confined to one or two loculi, this being particularly so in the case of mandarins.

In addition to this drying out, usually in the case of lemons, and less frequently with oranges, an attack by a bug is followed by the formation of a gummy substance inside the fruit.

With the lemon it appears that this is true of every injured fruit larger than 1½ inches in length. With the orange, which most frequently drops from the tree soon after injury, the gumming is not so often found.

Generally speaking, the larger the fruit the more badly it is gummed, providing, of course, natural conditions prevail. The degree of gumming further appears to depend on the extent to which the bug has fed on the fruit and the length of time it remains on the tree after the attack. These factors are no doubt interdependent to a great extent.

The above probably explains why the gumming has not been noted in the case of any variety of mandarin, for these fall so easily when attacked.

Gumming of Fruit.

The gumming appears to follow a disintegration of the tissues and the extent varies within wide limits. In the most severe cases it is found that more than a quarter of the pulp has broken down and its place been taken by the gum. In earlier stages, or perhaps less severe

attack, the gum may be confined to just below the rind and extending for a half inch or less just at the outside rim of the pulp. Occasionally the gum is formed in the rind itself, and then may or may not be present in the pulp.

The disintegration appears to start just under the rind and extend gradually inwards towards the centre. Usually the extension inwards follows along one or more of the septa and, in the more advanced cases, the seed is affected and aborted.

The presence of the gum may be indicated by a somewhat blistered appearance on the rind, but unless the fruit has yellowed there is generally no indication on the outside as to whether or not the fruit is gummed internally.

In a few cases gum is found to extrude from the surface through the puncture which the bug has made. This, however, is rather uncommon.

The absence of some external character by which a gummed fruit may be identified may be followed by loss to the grower, for by marketing gummed fruit his brand may quickly loose its good reputation with regular purchasers.

Fortunately, however, there is one method by which a gummed fruit may be identified with reasonable certainty. It is found that when squeezed in the hand the gummed fruit remains firm, whereas the sound one gives slightly to the pressure. With experience there is little chance of a careful grower culling sound fruit or marketing unsound ones in appreciable quantities.

In addition to this gumming which follows the attack by the bug there is another form found in lemons in Queensland. Frequently the two forms are confused—the bug generally now being held responsible for all such disintegration of the fruits. However, the two forms are distinct in primary origin. The second form corresponds fairly fully with the description given by Fawcett and Lee of what is termed by them Endoxerosis. This form corresponds closely in appearance with that caused by the bug, but the two may be distinguished from one another by the fact that in the case for which the bug is responsible there is always a yellow or brown discolouration of the rind along the path the proboscis has entered, whereas in the other form there is no such discolouration, and the injury is confined to the portion under the rind. The bug injury is most prevalent in the summer months, while the other appears to be practically confined to the cold weather.

It is considered, however, that the production of the gum in both cases is due to the existence of the same fundamental condition in the fruit. From investigations by Coit, Hodgson, and Bartholomew it is known that citrus leaves, when suffering from lack of water, tend to draw on the fruit for supply, and from Fawcett and Lee's conclusions it would appear that in internal decline this drawing off of the water in the fruit is connected with the formation of gum following a disintegration of the tissues.

It would appear possible then that the bugs, by withdrawing the solutions, set up somewhat the same condition in the fruit as is the case when the leaves have to make up their deficiency of water. That is to say, the formation of the gum following an attack by the insect is associated directly with the fact that the water content of the fruit has been lowered, and thus very closely corresponds to the Endoxerosis of California.

E. Jarvis, in 1914, recorded that bacteria were isolated from the gum in lemons, but as he went no further with the work there is no indication of their actual role.

During the course of this present investigation many examinations have been made, but no bacteria have been found in association with a freshly-cut gummed lemon.

Inoculation experiments have been carried out on four occasions. The fruit, in various stages of development, were inoculated with both a sterile needle and with a needle dipped in the gum of another lemon. In no case has the inoculation been followed by the production of a condition resembling that of a gummed lemon. The only effect consistently produced in the treated fruits was the brown discolouration of the rind, very similar in all appearances to that produced by the insertion of the proboscis of the bug. It would thus appear that the possibility of the gum being produced by the action of bacteria is remote.

Whenever bugs were enclosed with fruit on the tree the typical gumming was produced unless the fruit dropped within five days.

Mr. L. F. Mandelson, Assistant Pathologist, carried out cultural experiments using potato dextrose agar medium. Portions of gum and tissue in its vicinity were planted out on to plates of this medium and then incubated at 27 deg. Centigrade for fourteen days. At the end of that time out of twenty-one plantings nineteen were apparently sterile, while two showed some bacterial growth.

Mr. Mandelson, in reporting, stated: "It is considered that this growth was the result of contamination from an external source. Since potato dextrose agar medium is capable of supporting the growth of the vast majority of fungi and bacteria met with in pathological work it is further considered that the gum is sterile."

In view of all the above evidence it is thought that the formation of the gum is brought about by physiological causes and not by bacteria or other organisms, and is in itself fundamentally the same whether forming through the true physiological internal decline or following the attack by the bug.

The only way in which the condition following the bug's work apparently differs from Endoxerosis as described by Fawcett and Lee is that in no case of the former has the gum been found to occur in the wood vessels of the fruit-bearing stem.

Size of Fruit Attacked.

The insect attacks fruit in all stages of development, from that just setting to fully-matured ones.

In general it is found that the most forward fruit available are preferred.

This rule is subject to what has been recorded with respect to varietal preference except in the spring months of the year. At this time the main crop of mandarins is just setting, and it is found then that the bugs will move to what are normally less favoured varieties holding late or second crop fruit which is in an advanced state of development.

This last fact may be put to use, for by keeping this late maturing fruit under observation during the spring months a trap can be set and the bugs destroyed by systematic handpicking. It will be seen that until the main crop reaches the size of a marble the bugs will, for the most part, attend to lemons and the late oranges.

LIFE HISTORY.

A—Life Cycle.

As is usual for this type of insect there are seven stages in the development—i.e., the egg, five larval instars, and the adult or mature bug. No exception to this number of larval stages has been noted as is sometimes the case with other species of bugs.

With respect to the times taken for development there is a great deal of variation, the principal factors being temperature (probably in conjunction with humidity), and the quantity and quality of available food.

From field observations, it appears that the times of development taken for bugs in the laboratory are rather longer than what is required under natural conditions.

The various times taken for total development in the laboratory are given in tabulated form in Table I.

Table II. gives a summary of the information obtained concerning the development of the various immature stages.

One fact in connection with the data quoted concerning the various maxima and minima must be noted—namely, it is often found that when a particular bug goes through one stage with abnormal rapidity or abnormal slowness this divergence from the average is usually somewhat compensated for in the subsequent development. In Table I. will be found several bugs developing from eggs laid 31st December, 1930. The first of these listed required eleven days to complete the fourth instar, whereas the second took only six days. However, these bugs for fourth and fifth stages together occupied twenty and nineteen days, respectively. It is thus well to remember when reading Table II. that the figures given for maxima and minima are not necessarily as significant as might appear.

Laboratory breeding showed that the times taken for development, in general, did not vary any more between the same period in different years than at the one period of the same pear. For example, the times taken for total development of bugs commencing 3rd March, 1930, varied from forty-two to forty-five days, and those commencing 3rd March, 1931, occupied from thirty-eight to forty-four days.

It will also be noted with regard to individuals developing on or about the same date that generally the times taken for egg hatching and completion of the first and second instars vary but slightly with the different bugs, but that in the last three instars the periods differ greatly. Again, the point concerning compensating times in successive stages has to be remembered.

With regard to the actual periods of development these are set out in the first two Tables, and need not be discussed here.

Under the circumstances in which the work was done, it was not practicable to carry out properly-controlled experiments from which to determine the exact influences of temperature and humidity. As would be expected, there is reason to believe that both these are important factors.

Daily weather data have been noted at Gayndah throughout the whole period of the investigation, and though by this method no definite conclusions could be arrived at, certain facts are strongly indicated,

particularly with regard to the influence of temperature, both on the rate of development and the whole course of reproductive activity.

From Table I. it will be seen that as the summer approaches the rate of breeding accelerates, and that it remains fairly constant through the hot months. When the weather again commences to be cooler the rate is retarded.

A study of the records of maximum and minimum temperatures for each twenty-four hours leads to the conclusion that a lower limiting factor to reproductive activity is provided by a combination of temperatures. This combination consists of a maximum minimum of 40 deg. and a minimum maximum of 80 deg. Fahr. That is to say that, provided the temperatures in each twenty-four hours for about ten days or a fortnight do not fall below about 40 deg., and at the same time reach as high as 80 deg., there will be oviposition. It is difficult to decide which, if either, of these temperatures exerts the greater influence. From all the evidence, it appears that in the spring months the minimum temperature is the more important, while in the autumn the maximum has more bearing. This last is no doubt interdependent with other factors.

The chief of these other factors is probably the state of the trees and their fruit. Lemons differ in their fruiting habits from all other varieties in normal health, and as the lemon provides one of the most favoured foods, it appears more sound to reason from the state of affairs with regard to that variety than from those of other trees which normally have but one setting of fruit each year.

In the spring and autumn, when breeding is stimulated and retarded, respectively, on the lemons, there are fruits in approximately the same stages of development. It would, therefore, seem that breeding is not directly dependent on the state of the fruit.

The one big difference in the state of the trees is the condition as regards the sap. In the spring when development of the bugs is stimulated the sap is rising, whereas in the autumn the sap is going down.

It is possible, then, that if the sap be rising and the temperature for the period mentioned does not fall below 40 deg. there will be reproductive activity, but if the sap be going down the temperature must reach 80 deg. or oviposition will be discontinued.

Of course, temperature plays an important part in the determination as to the flow of sap, and the factors now put forward as being of controlling influence in the breeding of the bug are therefore themselves not independent. To definitely establish this contention concerning temperature influence would require much more time than was practicable to devote to it, but it can be said to agree with all the known facts for two successive years in particular, and with all the indicated facts for more than five years.

With respect to humidity, it appears that, though perhaps accelerating or retarding development according to various degrees of humidity in conjunction with temperature, this does not play a very important part in normal times. At only one period in the course of the last two years did oviposition and development become obviously affected after having commenced or ceased at normal times. This was in January, 1931. During that month the temperature at Gayndah reached 100 deg. on all but four of eighteen successive days, and only on two days was the minimum recorded below 70 deg. It may be that the extreme temperatures (up to 103 deg.) were responsible, but more probably the

very low humidity was the true cause of an almost complete stoppage of both oviposition and larval development. During the period under discussion the humidity was negligible, the leaves of the trees were curled and drooping, and as has been said reproductive activity was at a standstill.

In breeding work in the laboratory it was found that moisture had to be constantly supplied to ensure normal egg hatching and development of first instar bugs.

It may be that this humidity factor explains why *Biprorulus* does not cause more damage in the far west of the State where there are a good number of excellent citrus trees.

At the same time the insect is essentially a dry climate one, and there is no doubt that temperature exercises much more influence over it than do the normal humidities of localities in which the investigation was conducted.

B—Seasonal Life History.

There are four generations each year. The bugs overwinter as adults and oviposition is commenced early in September. The eggs then produced represent the beginning of the spring generation. Egg-laying is continued without interruption from this time onwards until about the end of October.

Development of the first eggs and the bugs to which they give rise is relatively slow, but soon this is accelerated, and it is found that the periods taken for the total development of the later bugs are so much shorter that the adult stage is reached by the great majority of bugs at about the same date.

It is very exceptional to find eggs in the field during the second and third weeks of November, and for all practical purposes it can be considered that oviposition ceases at the end of October, and does not recommence until almost the end of November, at the earliest.

After reaching the adult stage, which in the case of the spring generation is during November, a period of approximately a fortnight elapses before the eggs for the next generation are deposited.

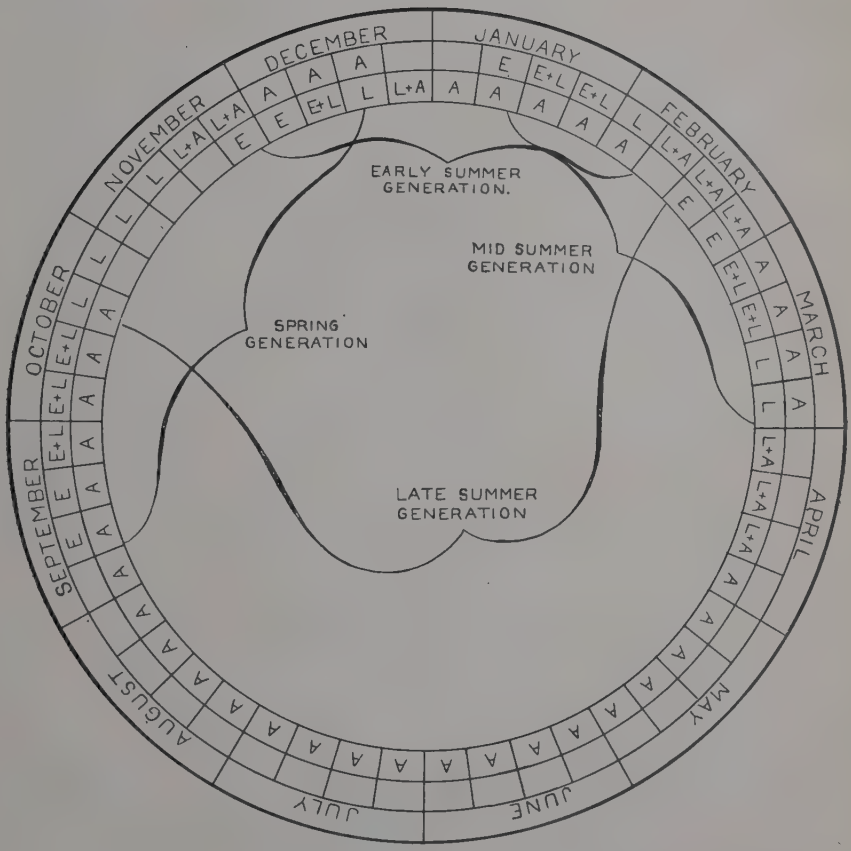
In very late November, then, or more typically early December, a second series of eggs is deposited. From these eggs arise the second or early summer generation bugs.

From now on the development is more rapid than previously, and adults of this early summer brood are to be found in the orchard during the first week in January or even during the last few days of the old year.

A similar pause again occurs before oviposition commences, and then a third or mid-summer generation begins to make its appearance. The rate of development is again rapid, and in general the times occupied by the bugs of this generation in completing their life cycle are approximately the same as those for the previous brood. If anything, the mid-summer bugs are rather quicker in developing. The adult stage is reached again early in February.

Soon reproduction is once more commenced, and the fourth or late summer generation begins. The adults of this brood are those which live through the winter, and ultimately give rise to the spring generation in the following September.

KEY
E = EGGS
L = LARVÆ
A = ADULTS



SEASONAL LIFE HISTORY OF BIPRORULUS BIBAX BREDDIN.

I.W. Helmsing after W.A.T. Summerville

PLATE 142.

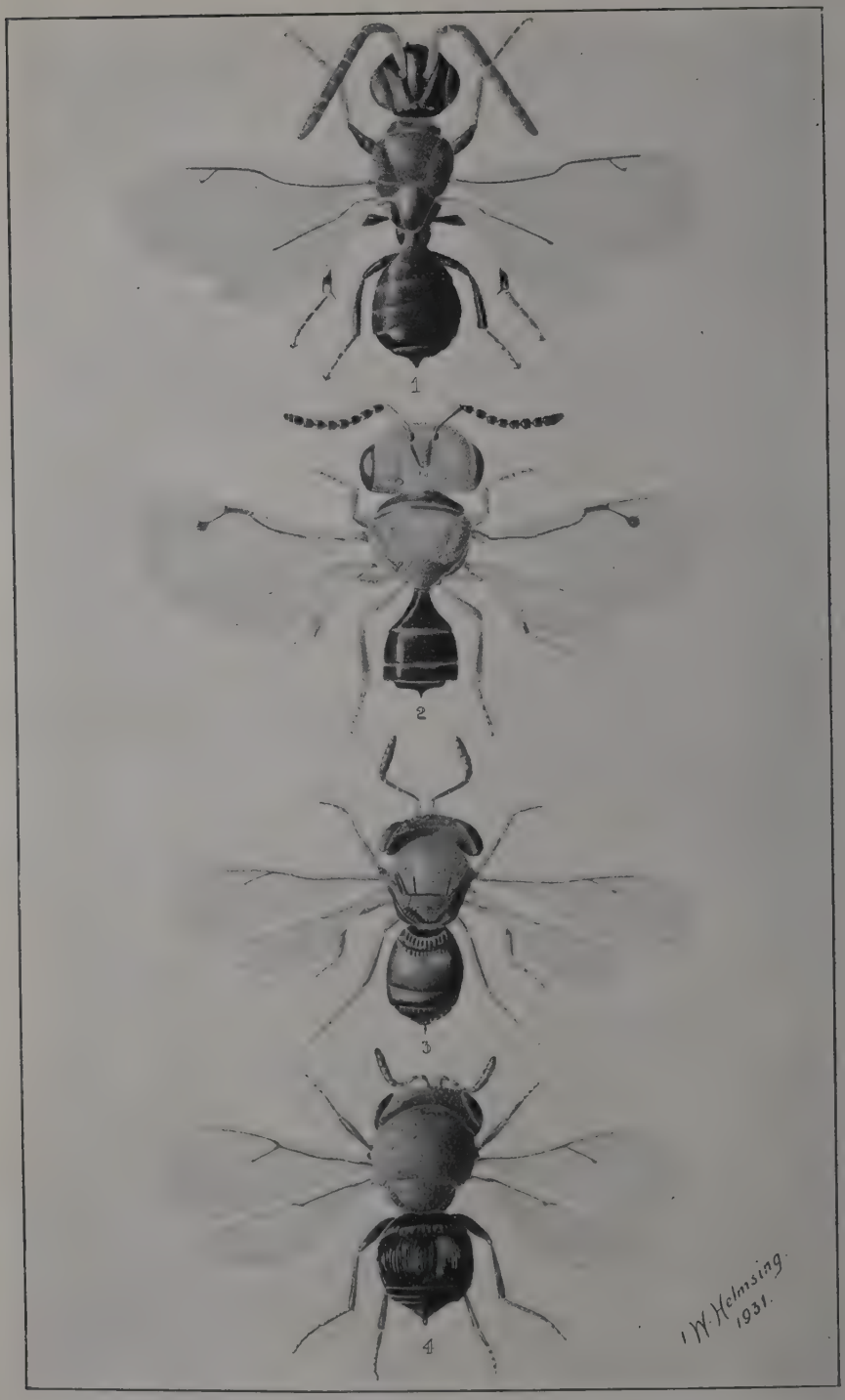


Plate 143.—Egg Parasites of *Biprorulus bibax* Breddin.

Fig. 1—*Eupelmus biproruli* Gir.
Fig. 2—*Pachycrepis tectacorisi* Gir.
Fig. 3—*Trissolcus flaviscapus* Dodd.
Fig. 4—*Telenomus biproruli* Gir.

(All figures × 23.)

Egg-laying is carried on with respect to the late summer generation for a rather long period. It commences in mid-February, and apparently is habitually carried on until the end of March. In a normal year bugs developing from these very late eggs show a very high percentage mortality—the experience in the laboratory being that if a bug had not reached the third stage by the middle of April it died before reaching maturity. In an abnormally mild season, such as was experienced during 1931 however, the mortality was not at all high.

In these abnormally mild years it was thought that a fifth generation might possibly be coming through. However, it was found that these late eggs were invariably deposited by adults of the mid-summer generation, and that no female of the late summer brood oviposited before having passed the winter. All late summer generation females which died before the winter were dissected, and none were found to contain any eggs.

A diagram (Plate 142) has been prepared which shows the essential points of the seasonal life history, and this should be read in conjunction with the foregoing notes. In this diagram the typical stages at each period of the year are shown, but it must be remembered that these, of course, are not necessarily the only stages which will be found at these times.

The seasonal life history as given above has been worked out during two years, and though the data for each of the two years agree very closely, it may be that in some subsequent year modifications will have to be made. This is purely a matter for the grower, and observations should always be carried out before accepting the statements as perfectly true for all localities and years. At the same time, it is felt that the variations will not be so great as to materially alter the general scheme as outlined.

During the course of the work observations were made frequently in widely separated localities, and it was found that there was surprisingly little difference in the times of appearance of the respective generations in these districts.

The method used in investigating the seasonal life history was to carry on breeding work throughout the year, and to make frequent periodical visits to the Gayndah district. When the field observations correlated with the data obtained in the laboratory suggested that a generation was nearing completion, fumigation of an entire orchard was carried out, and the orchard thus cleared of bugs. Thus the search for control methods was coupled with the life history work.

In examining an orchard and making counts of any stage of the insect, allowance had to be made for death due to natural causes. For example, if the number of fifth-stage insects was anywhere near that of first stage ones, then in general the fifth was the dominant stage. Actually it was only seldom that confusion was likely, and in all cases the data obtainable from the laboratory could be used to compute the true state of affairs.

Overlapping of Generations.

As has been indicated, egg-laying at the commencement of each generation is carried on for a considerable period. From Table III. it will be seen that the period of fecundity is at times considerably longer than the time required for the full development of individual

Plate 144.

Predatory on *Biprorulus bibax* Breddin.

Fig. 1.—Dorsal view of *Pristhesancus papuensis* Stål. × 6.

Fig. 2.—Lateral view of *Pristhesancus papuensis* Stål. × 6.

bugs. It might, therefore, be expected that a considerable amount of overlapping of generations would occur. Actually, the degree of overlapping is very small.

This is due, it is considered, to the following series of factors:—

The spring generation is begun early in September, and from that time onwards eggs are being laid continuously for about two months. In Queensland the true spring weather conditions are of rather short duration, the transition from winter to summer being fairly rapid. It thus happens that the bugs which are developing in October are maturing in much warmer weather than those which are under way a month earlier. The consequence is that bugs arising from eggs laid in early September take so much longer to complete their various stages than those coming later that the rather wide divergence in the time the eggs are laid is offset to a considerable extent. Thus the adult stage is ultimately reached by the greatest proportion of the bugs at approximately the same period—that is, one egg may be laid, say, a month after another, and yet it is quite possible that the adults will appear within a day or so of one another. Thus there is a combination of a relatively long life cycle and quickly-changing weather conditions tending to equalise the times at which the eggs of the next generation will be laid.

Following this comes the early summer generation. This, as has been recorded, makes its appearance about the beginning of December. At this time in each of the last three years egg parasites were particularly active. So active were they that it was only with difficulty that sufficient material could be obtained with which to carry on laboratory breeding work.

These parasites are particularly active during the first half of the month. At this time over 90 per cent. of the eggs found at Gayndah failed to hatch. The activity, though diminished later, is in evidence for almost the whole month.

Thus the numbers of adults maturing during the early summer is so small that the mid-summer generation starts off as almost a pure race.

From the beginning of the new year, however, overlapping becomes more and more manifest, until from the middle of March onwards it is possible to find bugs in the same instar, but belonging to two different generations.

As will be seen later, it is, fortunately, possible to establish a control of the bugs during January which eliminates, or at least reduces to a minimum, the effects of this overlapping in and after February, in so far as it interests the citrus-grower, except in the most severe infestations.

Natural Enemies.

There are seven known natural enemies of the bug belonging to the insect world.

Of these, the following were identified by Mr. A. A. Girault:—*Eupelmus biproruli* Gir.; *Telenomus glabriscrobis* Gir.; *T. biproruli* Gir.; and *Pachycrepis teclacorisi* Gir. One was identified by Mr. A. P. Dodd as *Trisolcus flaviscapus* Dodd (Plate 143).

These five insects are parasitic on the eggs of the bug. They do excellent work and, as has been indicated, they are particularly active in December. At this time, in both of the years in which observations were made, over 95 per cent. of all eggs collected gave rise to one or other of these parasites. Of the five, *T. biproruli* was the most frequently encountered species.

The spring and mid-summer generation eggs are subject to but a very light attack by these useful insects, but during the month of February in each of the last four years the percentage of parasitised eggs was fairly high. Though undoubtedly much good is accomplished at this time in reducing the numbers of the late summer brood of bugs, the benefit to the grower is mainly derived through the activity on the early summer generation.

The excellent work done by these parasitic wasps, or flies as they are sometimes styled by orchardists, during December is both direct and indirect. Directly, the result is in reducing the actual number of bugs of the early summer, and from that of all succeeding generations; indirectly, the result is in minimising the degree of overlapping of generations. Of the two, probably the latter is the more important.

The reason for this great activity in the early summer is difficult to ascertain. It is possibly due to the fact that the bug by ovipositing in December does so at a period when a great many other species are in post embryonic stages of development. From general observations on Queensland insects, it is concluded that the period of greatest egg-laying activity is during October, and more particularly November. The parasites at this time are no doubt spreading their activities over the eggs of a large number of other species of insects. Then in December these other insects are not so actively ovipositing, and the parasites are thus concentrated on the eggs of a comparatively smaller number. It must be emphasised that reference is being made in comparative terms, and not that it is thought that the actual number of insect species ovipositing in December is small.

The remaining insect enemies are predators. These are bugs which feed on all active stages of the pest. They are *Pristhesancus papuensis* Stål (Plate 144), and a small Asopid, the identity of which is not definite, but it seems to be a species of Amyotea. Mr. H. Hacker, to whom specimens were referred, considers that it is probably *A. (Strachia) erythromela* of Walker. There is little doubt that this is the correct name.

Of these two, though both are responsible for much good work at times, especially against the larval forms, the firstnamed is by far the most valuable. *Amyotea* is rather too spasmodic in its occurrence in numbers to be of much use in controlling the pest.

The efficacy of both of these predators is considerably reduced owing to the fact that their operations are by no means restricted to the pest in question.

Development of the Egg.

As egg parasites are a very important factor in the economy of the pest, it is advisable that citrus-growers should be able to recognise whether or not an egg is ultimately going to give rise to a friend or a bug.

The development of a normal healthy egg (Plate 139) is very characteristic, and many of the changes are visible to the naked eye. The following is a description of the changes in the appearances of a normal, rather slowly developing, egg:—

The egg was laid between 5 p.m. on Wednesday and 8 a.m. on Thursday. When first found, it was slightly more translucent at the top or micropylar region than elsewhere. Later, this difference disappears. By Saturday morning, towards the base of the egg, two scarlet

spots somewhat elongate in shape could be seen (these are the eyes). Lower down there were two sets of orange-coloured markings (these are the basal and apical joints of the antennæ). Between the eyes and extending downwards could be seen the central portion of the head coloured orange. A rather more opaque area marks the position of the proboscis, but this is difficult to see without a lens. By Sunday night a dark ⊥-shaped mark appears above the head and eyes (this is the egg burster). By next morning the egg burster appeared as an almost black triangular area. The antennæ were becoming somewhat brownish in colour, and the legs could now be seen as dark lines towards the base of the egg. By Tuesday all these parts were showing more prominently. The egg commenced to hatch at about 8.30 a.m. on Wednesday. After the egg had hatched, the black triangular egg burster remained fixed to the rim of the lid or operculum.

The above development was typical in all particulars of every normal egg, though, of course, in the hot weather the rate will in general be much quicker, and consequently the time of appearance of the various parts of the embryo will be earlier in such cases than was the case with the one described.

It may be noted that at times the developing embryo changes its position relative to the shell in which it is enclosed—the head being moved nearer the micropyle.

It will also be noted that the position of the embryo in every egg of a batch in most instances is almost exactly the same—i.e., if the head appears on the left side of the egg in one egg it will be on the left side of every egg, and almost the same distance from the rim of the operculum. This gives a batch of developing eggs a very characteristic appearance, and enables the various parts mentioned above to be very readily observed.

When an egg is parasitised (Plate 139) or infertile, the only colour changes which take place do so over almost the whole surface more or less uniformly.

The infertile egg usually collapses in parts and becomes grey or remains pearly in colour.

The parasitised egg when in an advanced state is pearly cream colour, with the micropyle somewhat grey.

It is advisable for growers to make themselves familiar with the appearance of a normally developing egg, and thus be in a position to recognise whether or not the egg will finally give rise to a bug.

It will be found that in general if one egg of a batch is parasitised, then every egg in that batch is in the same state. It is very unusual to find only a portion of a batch so attacked. Infertile eggs are seldom found in an orchard.

CONTROL.

A—General Considerations.

In the study of how a pest may be most efficiently controlled, when considering any actual mechanical, chemical, or other mode of killing the individuals, the various points of the life history and habits of the insect have to be taken into full account. Though every such point is of some

moment, there are generally a few which are of outstanding importance. In the case of the Larger Horned Citrus bug, the most important facts are:—

1. The insect feeds by sucking the juices of the plant, and this is accomplished by inserting the proboscis below the surface of the host.

2. The outside covering or exoskeleton of the pest's body is very hard, and would be difficult to penetrate directly with chemicals which would not harm the plant.

3. The species goes through four life cycles per annum. Overlapping of these generations is of no great extent before February. From the end of February onwards the overlapping may become very pronounced.

4. The only period between September and April in which eggs are very rarely laid is during the first three weeks of November (this time may vary, as has been pointed out). During the winter months the adult is the only stage in which the insect is to be found.

5. Just prior to each egg-laying period there is the probability of adults arriving in the orchard, having migrated thence from the native host plant.

6. It is economically impossible to remove the known sources of this infestation, and even if this were practicable it is considered possible that there is at least one other host which is not known as yet.

7. The intensity of the migrations varies. During the years in which the investigation was in progress, the spring arrivals were of little direct importance. The number arriving in early summer was also small. The migration of adults, in late December and early January, which give rise to the eggs of the mid-summer generation, is of the utmost importance, not so much from the point of view of numbers, though these are considerable, but more particularly on account of the subsequent breeding. The last migration is of no great importance except in extreme cases, which are rare.

8. The migration is usually intense for not longer than a fortnight; usually it takes place from one direction only.

9. Egg parasites are responsible for a great reduction in the number of early summer generation bugs, and for an appreciable diminution in the number of bugs developing late in February or early March.

10. The evidence obtained all points to the fact that the bug is attracted from long distances into the orchard by lemons only.

11. The bugs during the spring months favour late and second-crop fruit, which is in an advanced stage of development, in preference to the recently set fruit of what might, at all other times, be a very desirable variety to them.

12. For preference a bug will select a thickly leafed tree to one of the same variety with more scanty foliage.

13. The bug spends the greater part of the day on the fruit, and is most easily observed from four o'clock onwards till dusk or early in the morning.

14. Flying is generally undertaken to any extent only after the sun has begun to get low on the horizon. When molested, the bug is more likely to endeavour to escape by crawling than by flying—at least, in the first place.

15. Clusters of adults may occasionally be found in the trees during the winter.

16. The longest period over which egg-laying has been noted by any normal female is eighty-one days.

17. Egg-laying does not commence until about a fortnight after the adult stage has been reached.

18. The times occupied in development at any period of the year are important, particularly those of the egg and complete life cycle.

B—Means of Control.

From the fact recorded in "A," paragraph 1, it will be at once apparent that stomach poisons administered in the form of a spray or dust will be quite useless against the insect.

Owing to what was recorded in "A," paragraph 2, it would not be expected that any but the strongest contact insecticides would be at all effective.

However, the effect of each of the more commonly used contact insecticides was tested. It was found that none of these had any appreciable lethal action on the pest. Nicotine sulphate, even at strengths far in excess of those usually employed, was shown to be quite useless.

Lime sulphur wash used at 1 to 8 appeared to have some deterrent action. Certainly the adults left the sprayed trees; but that they would actually leave an orchard sprayed throughout is very doubtful. At all events, the spray is useless against this pest, as it could not be used at the required strength at the times most needed, for the trees would be very badly damaged.

A resin wash made to the formula 2 lb. resin and 1 lb. washing soda to 30 gallons of water when applied early in the morning effectively brought adults and the last two-stage larvæ to the ground. These bugs when brought down were incapable of flying or any quick movement. They could thus be collected and destroyed. None but the very young larvæ were killed. The spray is difficult to handle effectively, and its general use could not be recommended on the results obtained in the tests.

A spray made up as follows was found to be effective against all the active stages of the bug:—10 lb. of finely-ground resin is mixed while dry with 3 lb. of good commercial caustic soda, and the mixture boiled until a clear dark solution is obtained. To this solution is added 1½ lb. fish oil, and the whole boiled for a few minutes.

For the boiling, 2 gallons of water are used. As the solution expands greatly when hot, the container used should hold at least 4 gallons, otherwise boiling over may take place. The solution thus obtained is then diluted to 40 gallons by the addition of 38 gallons of cold water. Actually, the volume of the solids will make the final volume slightly more than 40 gallons.

This spray must not be used in the very hot weather, as burning of the fruit and twigs may occur at that time.

This last fact reduces the value of the spray as a means of controlling the pest, but at the time when control measures are most needed, there are very few spray materials known which could be used without some ill effects on the tree resulting.

Fumigation by the use of hydrocyanic acid gas has been tested, and when this gas is generated from calcium cyanide, has been proved to be very effective.

When generated by the interaction of sulphuric acid and either potassium or sodium cyanide, however, hydrocyanide acid gas does not give the same satisfactory results.

When this so-called pot method is used, the bugs are quickly brought to the ground, but it was found that up to 40 per cent. of the bugs thus dislodged from the trees recovered after a few hours' exposure to pure air. If the pot method be used, it is necessary to collect by hand the bugs which fall, and then destroy them by some other means.

The reason for this difference in the results following the use of the same fumigant lies, no doubt, wholly in the method of its production. With the pot method, the gas is generated very quickly, while when calcium cyanide is used, the evolution of the gas is slower and extends over practically the whole forty-five minutes usually allowed.

The inferiority of the pot method may be accounted for by there being a greater loss of the gas due to the sudden rush with which it is produced.

More likely the superiority of the slower method is due to the following:—When the gas first envelopes the insects after having been liberated merely by the action of the atmosphere, it does so in sufficient quantity only to cause them some discomfort. They are thus able to follow their inclination to grip the tree more firmly. The gas continues to come to them more or less gradually, and by remaining on the tree they receive a larger quantity than they would have had they fallen at once. With the acid-using methods the insects are almost instantaneously enveloped in an atmosphere containing a high concentration of the poison. They are thus at once stupified, and fall to the ground. The gas in this case is being evolved so that it comes into the atmosphere of the tent at some height above the ground. Hydrocyanic acid gas is lighter than air, and therefore tends to rise. The insects by falling to the ground thus quickly pass to a region of low concentration. On the other hand, when the gas is being evolved from calcium cyanide dust, the evolution of the gas is taking place from the ground level over a large area under the tent. The bugs will thus not usually pass to a less heavily laden region.

The first part of this theory is substantiated by the fact that when calcium cyanide is used at 100 per cent. dosage for thirty minutes, the kill is about 5 per cent. lower on the average than when forty-five minutes is allowed. With potassium cyanide the kills are about the same with both periods.

The second part is supported by the fact that even 50 per cent. dosage of the dust form gave a better kill than the full strength potassium. When the 50 per cent. dose of the dust is used, it will be found that a number of the bugs brought down (up to 12 per cent.) recover.

A kill of 80 per cent. can be constantly obtained, using the dust at 50 per cent. for the full forty-five minutes, but if this dosage be used, it is advisable to pick up and mechanically destroy as many of the fallen bugs as may be practicable.

The tests which were made showed that by using calcium cyanide 100 per cent. dosage for forty-five minutes at least a 95 per cent. kill will be obtained against all active stages of the bug.

It will be found that after removing the tent a proportion of the fallen bugs are still alive, though very sluggish. It was proved that even when given every protection, less than 2 per cent. of the fallen insects ultimately lived. Sometimes two days elapse before they finally die, but there is no doubt that if allowed to remain in the orchard exposed to the weather, attack by ants, &c., that the percentage recovering would be even smaller. Growers, therefore, need not be concerned about these moving insects which are sometimes to be observed.

Catching the insects and destroying by hand is, of course, far too slow and too costly to be carried out on a very large scale, even if practicable. However, handpicking in conjunction with other methods is very useful, and the practice is by no means to be discouraged. Even when carried out haphazardly much good may be accomplished by this handpicking, and when done systematically and with due regard to relevant points of the life history and habits, it is often all that is required in some districts. However, consideration must be given to these points, as otherwise much time may be wasted. For example, to set out on a handpicking expedition during the middle of a hot day because it is then a congenial task is useless, because for every bug seen it is probable that a dozen at least will be effectively hidden in the thicker parts of the tree. This sort of mistake is often made.

C—Recommendations.

The following methods of combating the pest have been adopted on the assumption that the seasonal life history will be the same for most years, as was found to be the case during the last two years. The methods have been tested and shown to be quite adequate for heavy infestations of the insect.

The recommendations are so worded that they apply directly to the Gayndah district unless some other locality is specifically mentioned. Though there is evidence that the data and facts on which they are based do not vary much in different districts or different years, it is advisable for growers to carry out sufficient observations to learn whether any adjustment of time is necessary before accepting them as true for all places and years.

(*a*) Where lemons are grown, particularly if in quantity, it is advised that all other varieties of citrus should be stripped of mature or second-crop fruit as early in the spring as it is economically possible to do so. The first eggs are laid in early September, and therefore the best results will be obtained by stripping before that month.

By carrying out this stripping, the adults will be attracted to the lemons, and therefore for the main part to a limited number of trees. This recommendation will be understood from what has been briefly recorded in paragraphs 5, 10, and 11 of "A," and from what has been recorded of the seasonal life history and varietal preference. Depending on the intensity of the infestation following the arrival of bugs from the native host, the lemons should then be systematically handpicked or fumigated. In general, handpicking should suffice, but when fumigation is necessary, this should be delayed until November, if at all possible. This delay is advised for two reasons—during this month eggs are practically absent and a better kill of scale insects will be obtained at that time than would be the case if the work were done earlier in the season.

Handpicking should be systematically carried out and practised either early in the morning or late in the afternoon. Refer to paragraph 13 of "A."

(*b*) Where it is not economically possible to remove all late and second-crop fruit by the time specified in (*a*), at least remove all the fruit from other varieties, particularly favoured mandarins. The older fruit, which, of course, will be nearly always oranges, should then be regularly examined, and bugs found on them dealt with at short intervals. The late fruit is thus really being used as a trap crop. If correctly carried out, this recommendation can be put to great service, but if the attention given is not thorough, these trap trees will probably act as a prolific source of bugs. Further, when the orchard has been planted in such a way that these late varieties are indiscriminately mixed with mandarin trees, it is not a safe procedure to rely too much on the attraction of the mature fruit for the insect. When fresh planting is contemplated, it will be wise to bear this fact in mind.

(*c*) From what has been recorded in brief in paragraphs 7 and 9 of "A," it will be seen that it will be seldom necessary to apply control measures in early December, particularly if recommendations (*a*) and (*b*) have been carried out. If the number of bugs in an orchard seems to be very great, it will be advisable to collect a few batches of eggs from various parts of the orchard, and watch their development. If the parasites are not so active as would be necessary to adequately reduce the number of bugs, confine the control measures to handpicking if possible, otherwise use the resin, caustic soda, fish oil spray. Fumigation should not be undertaken if at all avoidable. If this last be used, half-strengths followed by picking up of fallen bugs should be employed.

If the parasites be reasonably active, it is worth while risking breeding a few extra bugs rather than killing many useful insects by indiscriminately destroying all eggs.

(*d*) In January, control measures will most likely be required. In fact, it is considered that this is the key period in the successful control of the pest. The other recommendations are essentially of but secondary importance to most orchardists.

Fumigation by the use of calcium cyanide should be carried out as soon as the migration of adults to the orchard has lost its intensity. The actual time may vary, but during the period of the investigation fumigation commenced during the latter portion of the second week in January met with great success. By delaying too long, the females will be allowed to commence ovipositing, and by starting too early, all the migrating adults will not yet have arrived in the orchard. The margin of safety is not large, but it is sufficient if the required observations are made.

The fumigation operations should be commenced on the side of the orchard remote from the source of infestation, and advanced towards that direction.

The reasons on which this recommendation is primarily based will be found in paragraphs 4, 5, 7, 8, 10, and 17 of "A." If this recommendation be not carried out, overlapping of the broods may make it necessary to fumigate twice in February, as described in (*e*).

(*e*) If the previous recommendations, especially (*d*), have been correctly carried out, it will be found that in the vast majority of cases

no further efforts need to be made to cope with the pest. Of course, handpicking will at all times be carried out, when the opportunity offers, by careful growers.

In very extreme cases the infestation may be so great, due to a prolonged migration, that a second fumigation is necessary. If this be the case, the double cyaniding may be done, using half-strength dosage for one or other, preferably the first. The second fumigation should follow the first at an interval of not less than six days, and not more than about thirty days. These times are dictated by the rate of development of the eggs and the period occupied by the bug in completing its life cycle at this time of the year. The eggs may take up to six days to hatch, and though the adult may mature in less than thirty days, an extra few days can be allowed because reproductive activity does not follow immediately on maturation.

(*f*) In districts such as Howard and the Maroochy area, it is recommended that unless lemon trees are of some commercial value, they should not be grown near an orchard. If such lemons be retained, close observations should be made at the time of commencement of each generation, and all bugs found on them destroyed at once.

(*g*) When planting a new orchard in a district in which the direction of infestation is known, the lemon trees should be planted on that face of the orchard nearest the source of infestation. This will have the effect of retarding the spread of the pest through the orchard.

(*h*) As the bugs prefer the more heavily foliaged trees, it is advisable to keep trees of favoured varieties pruned out as well as possible, giving due consideration to other effects of this on the trees.

(*i*) When pruning in the late winter close watch should be kept for clusters of adults in the trees, and when found these should be at once destroyed.

(*j*) Finally, on account of the destructiveness of the species, and the fact that when climatic conditions favour it, it is likely to cause severe damage in almost any district, no opportunity should be lost of destroying individuals, even though the bug may not be known as a pest on the particular orchard. It must be regarded as at least a potential pest of every citrus-grower in the State.

Acknowledgments.

In the course of this investigation, orchardists in many districts have given every assistance possible, and thanks are tendered to them. In particular, throughout the Gayndah district growers have given very valuable help, and though it is difficult to discriminate, Messrs. R. A. Uleoq, T. Gishford, and M. Kenny, without whose assistance the work would have been at least prolonged, may be specially mentioned.

On the technical side, thanks are due to those members of Head Office staff who have assisted at all possible times. Mr. A. R. Brimblecombe's help in the laboratory made it possible to carry on breeding work throughout the year without interruption, and the efficiency with which the work was done is shown by the high percentage of available insects he successfully reared from egg to adult. Mr. I. W. Helmsing's artistic contributions are as excellent as ever. And, finally, Mr. Robert Veitch's valuable advice, given whenever sought, was much appreciated, as also was his courtesy in making available the help of members of Head Office staff.

TABLE I.

PERIODS TAKEN BY INDIVIDUAL BUGS TO COMPLETE LIFE CYCLE.

Egg Laid.	Developmental Periods in Days.							Reached Adult.
	Egg.	First Instar.	Second Instar.	Third Instar.	Fourth Instar.	Fifth Instar.	Total.	
				Spring Generation.				
7–9–29	12	6	11	13	13	20	75	21–11–29
								22
10–10–30	5	5	7	8	7	10	42	22–11–30
10–10–30	5	5	7	8	9	9	43	23–11–30
10–10–30	5	5	7	9	10	13	49	29–11–30
10–10–30	5	5	8	8	7	12	45	25–11–30
15–10–30	6	6	9	8	7	9	45	29–11–30
24–10–30	5	5–6	11–12	14	14	10	60	21–12–29
31–10–29	7	5	8	2–4	7–9	16	47	18–12–29
31–10–29	7	6	8	5	8	10–11	44–45	15–16–12–29
				Early Summer Generation.				
8–12–30	4	5	6	4	4	7	30	7–1–31*
11–12–30	4	4	5	5	9	12	39	19–1–31*
11–12–30	4	4	5	8	6	8	35	15–1–31
11–12–30	4	4	5	7	10	9	39	19–1–31*
13–12–30	5	4	3	5	6	7	30	12–1–31†
13–12–30	5	3	6	9	7	14	44	26–1–31
14–12–29	4	5	2–4	10–12		9	32	15–1–30§
14–12–29	4	4–5	4–5	10		9	32	15–1–30
14–12–29	3	4	6	15		9	37	20–1–30§
14–12–29	3	4	6	13		11	37	20–1–30
14–12–29	3	4	6	10		14	37	20–1–30‡
14–12–29	3	3	4	20		8	38	21–1–30‡
14–12–29	3	3	4	20		9	39	22–1–30‖
14–12–29	3	3	4	15		12	37	22–1–30
14–12–29	3	3	4	21		10	41	24–1–30
14–12–29	3	3	4	21		11	42	25–1–30
14–12–29	3	3	4	20		15	45	28–1–30‡
14–12–29	3	3	4	24		11	45	28–1–30
17–12–30	4	3	5	7	7	14	40	26–1–31*
17–12–30	4	3	5	7	7	11	37	23–1–31*
17–12–30	4	4	6	5	5	7	31	17–1–31†
17–12–30	4	4	6	5	5	8	32	18–1–31†
17–12–30	4	3	6	6	7	8	34	20–1–31*
17–12–30	4	4	6	5	5	10	34	20–1–31
17–12–30	4	4	6	6	5	9	34	20–1–31†
17–12–30	4	4	6	6	6	8	34	20–1–31*
17–12–30	4	3	6	6	7	10	36	22–1–31*
17–12–30	4	4	7	6	7	10	38	24–1–31†
17–12–30	4	4	6	7	7	11	39	25–1–31†
17–12–30	4	4	6	6	7	13	40	26–1–31*
18–12–30	5	2	6	5	4	5	27	14–1–31†
18–12–30	5	2	6	5	4	6	28	15–1–31*
19–12–30	4	4	4	5	5	8	30	18–1–31†
19–12–30	4	4	5	4	5	10	32	20–1–31*
19–12–30	5	4	3	5	6	10	33	21–1–31*
19–12–30	5	4	3	6	8	12	38	26–1–31*
19–12–30	5	4	3	9	7	10	38	26–1–31†

* Male. † Female. ‡ 2 Bugs. § 3 Bugs. ‖ 6 Bugs.

NOTE.—The number of bugs bred in the laboratory was too large to admit of the inclusion of all; the above are representative.

TABLE I—*continued.*

PERIODS TAKEN BY INDIVIDUAL BUGS TO COMPLETE LIFE CYCLE—*continued.*

Egg Laid.	Developmental Periods in Days.							Reached Adult.
	Egg.	First Instar.	Second Instar.	Third Instar.	Fourth Instar.	Fifth Instar.	Total.	
Mid Summer Generation.								
31–12–30	3	3	4	6	11	9	36	5–2–31
31–12–30	3	3	5	3	6	13	33	2–2–31†
31–12–30	3	3	5	4	8	10	33	2–2–31†
31–12–30	3	3	4	6	8	9	33	2–2–31*
31–12–30	3	3	4	6	10	12	38	7–2–31*
3–1–31	4	3	3	6	6	8	30	2–2–31*
3–1–31	4	3	3	6	6	9	31	3–2–31†
3–1–31	4	3	3	4	8	10	32	4–2–31*
3–1–31	4	3	3	4	8	10	32	4–2–31*
3–1–31	4	3	3	5	11	8	34	6–2–31
3–1–31	4	3	3	5	10	9	34	6–2–31*
3–1–31	4	3	3	5	10	9	34	6–2–31*
3–1–31	4	3	3	5	10	9	34	6–2–31†
3–1–31	4	3	3	6	7	11	34	6–2–31†
3–1–31	4	3	3	5	11	9	35	7–2–31†
3–1–31	4	3	3	5	11	9	35	7–2–31*
3–1–31	4	3	3	8	8	9	35	7–2–31*
3–1–31	4	3	4	6	9	10	36	8–2–31
3–1–31	4	3	3	5	10	11	36	8–2–31†
3–1–31	4	3	4	7	13	11	42	14–2–31†
31–1–31	5	4	7	5	5	8	34	6–3–31†
31–1–31	5	4	8	5	5	8	35	7–3–31*
31–1–31	5	4	7	4	5	8	33	5–3–31†
Late Summer Generation.								
18–2–31	4	4	4	6	4	7	29	19–3–31*
18–2–31	4	4	5	4	6	10	33	23–3–31†
18–2–31	4	4	5	4	5	15	37	27–3–31†
18–2–31	4	4	5	4	5	12	34	24–3–31‡
19–2–31	5	4	5	5	7	9	35	26–3–31*
19–2–31	5	4	7	3	8	14	41	1–4–31†
19–2–31	5	4	5	4	6	13	37	28–3–31†
19–2–31	5	4	5	5	6	15	40	31–3–31*
19–2–31	5	4	5	5	6	17	42	2–4–31‡
19–2–31	5	4	5	4	7	10	35	26–3–31‡
22–2–31	6	3	6	7	5	10	37	31–3–31†
22–2–31	5	4	5	3	5	8	30	24–3–31*
22–2–31	6	3	6	5	6	13	39	2–4–31*
22–2–31	5	4	5	3	4	18	39	2–4–31†
22–2–31	6	3	6	5	5	9	34	28–3–31*
23–2–31	6	3	6	3	6	12	36	1–4–31*
23–2–31	6	3	6	4	10	16	45	9–4–31†
24–2–31	5	4	7	5	6	10	37	2–4–31*
24–2–31	5	4	6	7	8	16	46	11–4–31*
25–2–31	5	3	7	5	5	9	34	31–3–31*
26–2–31	5	3	6	6	10	13	43	10–4–31*
26–2–31	5	4	4	10	8–9	18–19	50	17–4–31†
26–2–31	5	4	4	5	6	10	34	1–4–31†
26–2–31	5	4	4	6	6	10	35	2–4–31†
27–2–31	5	3	6	7	7	15	43	11–4–31*
27–2–31	5	3	5	6	10	23	52	20–4–31†
28–2–31	5	4	5	4	8	18	44	13–4–31*

* Male. † Female. ‡ 2 Bugs. § 3 Bugs. ‖ 6 Bugs.

NOTE.—The number of bugs bred in the laboratory was too large to admit of the inclusion of all; the above are representative.

TABLE I—*continued.*

PERIODS TAKEN BY INDIVIDUAL BUGS TO COMPLETE LIFE CYCLE—*continued.*

Egg Laid.	Developmental Periods in Days.							Reached Adult.
	Egg.	First Instar.	Second Instar.	Third Instar.	Fourth Instar.	Fifth Instar.	Total.	
Late Summer Generation—continued.								
28–2–31	5	4	5	6	8	12	40	9–4–31†
28–2–31	5	4	6	5	11	14	45	14–4–31*
28–2–31	5	4	6	5	8	20	48	17–4–31*
28–2–31	5	4	6	7	10	10	42	11–4–31*
3–3–30	7	3–4	4–5	4	9	14	42	14–4–30
3–3–30	7	3–4	4–5	6	8	13	42	14–4–30‡
3–3–30	7	3–4	4–5	6	11	11	43	15–4–30‡
3–3–30	7	3–4	4–5	5	11	14	45	17–4–30‡
5–3–30	6	4	5	6	7	12	40	14–4–30
5–3–30	6	4	5	5	7	13	40	14–4–30
5–3–30	6	4	4	5	8	14	41	15–4–30
5–3–30	6	4	6	5	7	14	42	16–4–30
5–3–30	6	4	5	7	7	14	43	17–4–30
3–3–31	4	3	4	6	8	15	40	12–4–31†
3–3–31	5	3	9	6	7	8	38	10–4–31*
3–3–31	5	3	6	7	7	9	37	9–4–31*‖
3–3–31	5	3	6	6	10	10	40	12–4–31†
3–3–31	5	3	6	6	10	14	44	16–4–31*
3–3–31	5	3	6	6	8	11	39	11–4–31*
6–3–31	4	4	4	5	6–7	9–10	33	8–4–31*
6–3–31	4	3	7	6	7	10	37	12–4–31†
6–3–31	4	3	7	6	7	11	38	13–4–31*
9–3–31	4	4	6	9	9	17	49	27–4–31*
9–3–31	4	4	6	8	10	12	44	22–4–31*
9–3–31	4	3	5–6	4–5	6	11	34	12–4–31*
9–3–31	4	4	7	9	12	15	51	29–4–31*
9–3–31	4	4	7	9	7	12	43	21–4–31*
12–3–31	4–5	3–4	5	7	12	18	50	1–5–31*
12–3–31	4–5	3–4	6	6	15	20	55	6–5–31*
12–3–31	4–5	3–4	6	6	6	13	39	20–4–31†
12–3–31	4–5	3–4	5	7	8	12	40	21–4–31†
12–3–31	4–5	3–4	5	7	9	13	42	23–4–31†
19–3–31	4	5	6	7	8	11	41	29–4–31†
19–3–31	4	5	6	7	8	15	45	3–5–31†
19–3–31	4	5	5	6	7	13	40	28–4–31*‖

* Male. † Female. ‡ 2 Bugs. § 3 Bugs. ‖ 6 Bugs.

NOTE.—The number of bugs bred in the laboratory was too large to admit of the inclusion of all; the above are representative.

TABLE II.

Data concerning Development of each Stage.

Generation.	Maximum.	Minimum.	Average.	Number.
	Days.	Days.	Days.	Eggs.
Egg Stage.				
Spring { Early Spring	12	5	8	68
Spring { Late Spring	7	5	6	228
Early Summer	5	4	4	108
Mid Summer	5	3	4	208
Late Summer	6	3	4-5	1,230
First Instar Stage.				Bugs.
Spring { Early Spring	7	4	6	53
Spring { Late Spring	6	4	4-5	48
Early Summer	5	2	3-4	55
Mid Summer	4	2	3	148
Late Summer	5	3	3-4	821
Second Instar Stage.				
Spring { Early Spring	14	8	11	14
Spring { Late Spring	11	6	8-9	28
Early Summer	9	3	5-6	47
Mid Summer	10	2	5	116
Late Summer	14	3	5	593
Third Instar Stage.				
Spring { Early Spring	13	10	11	6
Spring { Late Spring	15	5	11	20
Early Summer	10	4	6	37
Mid Summer	10	3	5	80
Late Summer	10	3	6	382
Fourth Instar Stage.				
Spring { Early Spring	13	13	13	1
Spring { Late Spring	10	7	9	9
Early Summer	12	5	6-7	36
Mid Summer	13	4	7	72
Late Summer	17	4	7	262
Fifth Instar Stage.				
Spring { Early Spring	20	20	20	1
Spring { Late Spring	14	11	11	6
Early Summer	16	9	9	52
Mid Summer	13	9	9	67
Late Summer	23	7	12	176

TABLE III.

OVIPOSITION TEST SERIES.

Series.	Became Adult.	Segregated with Male.	Oviposition Commenced.	Oviposition Ceased.	Period from Maturity to First Egg Laid.	Period of Fecundity.	Total Number of Eggs Laid.	Remarks.
					Days.	Days.		
P. 31·1 ..	14 Feb., 1931	14 Feb., 1931	28 Feb., 1931	1 Apr., 1931	14	32	48	Died 7th April, 1931; contained nine eggs when dissected.
P. 31·3 ..	..	14 Feb., 1931	7 Mar., 1931	29 Aug., 1931	*21	†175	105	Died 29th August, 1931; contained no eggs when dead.
P. 31·4 ..	..	14 Feb., 1931	21 Feb., 1931	13 May, 1931	*7	81	199	Died 17th May, 1931; contained two eggs when dissected.
P. 31·5 ..	..	14 Feb., 1931	26 Feb., 1931	29–30 Mar., 1931	*12	31–32	166	Died 8th April, 1931; without eggs after death.
P. 31·6 ..	..	14 Feb., 1931	27 Feb., 1931	29–30 Mar., 1931	*13	30–31	118	Six eggs found on dissection, 31st March, 1931.
P. 31·2 ..	5 Mar., 1931	5 Mar., 1931	21 Mar., 1931	14 Sept., 1931	16	†177	68	Died 25th September, 1931; contained six eggs when dead.
P. 31·7 ..	6 Mar., 1931	6 Mar., 1931	22 Mar., 1931	7 Apr., 1931	16	16	25	Died 23rd April, 1931; contained no eggs when dead.
P. 31·8 ..	19 Feb., 1931	19 Feb., 1931	..	..	..	0	0	The only apparently barren female found; died 23rd April, 1931.
P. 31·9 ..	19 Feb., 1931	19 Feb., 1931	6 Mar., 1931	29–30 Mar., 1931	15	23–24	55	Died 9th April, 1931; no eggs found when dissected.
P. 31·10..	19 Feb., 1931	19 Feb., 1931	10 Mar., 1931	13 Mar., 1931	19	3	25	Died 7th April, 1931; no eggs found when dissected.

* This is the minimum period; it may have been slightly longer, as the exact date on which the insect reached the adult stage was not recorded in this case. It is certain, however, that this female had not laid prior to the commencement of the test. † P. 31·2 and P. 31·3 behaved abnormally in that they were Mid-Summer brood bugs, which, after ovipositing at the usual time, lived and subsequently behaved just as do late summer adults. They thus gave rise to young of two generations. Such abnormality was extremely rarely met with.

RATIONS FOR DAIRY COWS.

E. H. GURNEY, Senior Analyst.

FEEDERS of dairy stock frequently forward to the Department lists of food material available to them, desiring to know how to make balanced rations from such material. On account of this it was thought that examples of rations made up with various feeds might prove useful, some of the examples being composed of food-stuffs named in the lists mentioned above.

The Agricultural Chemist, Mr. J. Brünnich, has written a pamphlet entitled "Stock Foods," in which the objects of feeding, description and analyses of various stock foods, and the making up of rations are all very fully detailed, and with this information the dairy farmer can judge how to feed to the best advantage.

Modern experience has shown that rations with somewhat lower protein content than was previously considered necessary can be successfully used.

Examples of rations computed from analyses of feed-stuffs contained in "Stock Foods" are given below, and are in accordance with the feeding standards for dairy cows published in "Feeds and Feeding Abridged," by Henry and Morrison.

Professor J. K. Murray states that this standard is referred to in lectures in the Agricultural Course at the Queensland University.

HENRY AND MORRISON FEEDING STANDARD.

	Digestible Crude Protein.	Total Digestible Nutrients.
Dairy Cows.		
For maintenance of a 1,000-lb. cow	0·700	7·925
To allowance for maintenance add—		
For each 1 lb. of 2·5 per cent. milk ..	0·045—0·053	0·230—0·256
For each 1 lb. of 3·0 per cent. milk ..	0·047—0·057	0·257—0·286
For each 1 lb. of 3·5 per cent. milk ..	0·049—0·061	0·284—0·316
For each 1 lb. of 4·0 per cent. milk ..	0·054—0·065	0·311—0·346
For each 1 lb. of 4·5 per cent. milk ..	0·057—0·069	0·338—0·376
For each 1 lb. of 5.0 per cent. milk ..	0·060—0·073	0·362—0·402
For each 1 lb. of 5·5 per cent. milk ..	0·064—0·077	0·385—0·428
For each 1 lb. of 6·0 per cent. milk ..	0·067—0·081	0·409—0·454
For each 1 lb. of 6·5 per cent. milk ..	0·072—0·085	0·434—0·482
For each 1 lb. of 7·0 per cent. milk ..	0·074—0·089	0·454—0·505

Then upon this standard, a 1,000-lb. cow, yielding 25 lb. of milk of 3.5 per cent. fat, would require from a minimum amount of digestible crude protein $0.049 \times 25 = 1.225 + 0.7 = 1.925$ lb. to a maximum amount $0.061 \times 25 = 1.527 + 0.7 = 2.225$ lb.; and this cow would require from a minimum amount of total digestible nutrients $0.284 \times 25 = 7.1 + 7.925 = 15.025$ lb. to a maximum amount $0.316 \times 25 = 7.900 + 7.925 = 15.825$ lb.

Again, a 1,000-lb. cow, yielding 25 lb. of milk of 4.0 per cent. fat, would require from 2.05 lb. to 2.325 lb. digestible crude protein, and from 15.7 lb. to 17.57 lb. total digestible nutrients.

The term "nutritive ratio" means that amount of digestible protein that exists in a feed compared with the amount of non-nitrogenous digestible nutrients in that feed. As fat is capable of producing more heat when digested than the other nutrients, the fat content in the following rations has been multiplied by 2.3 and the product added to the amount of digestible carbohydrate and fibre—this total divided by the digestible protein gives the "nutritive ratio" of the ration. Thus in No. 1 ration, there is one part of digestible protein to six parts of other digestible nutrients.

When considering rations for animals it must be understood that other factors, beside the digestible crude portein and total digestive nutrients supplied to the animal, must be taken into account, such as succulence, palatability, and variety of feeds.

Proteins are very complex bodies, and different proteins yield different substances when digested, and a number of these different substances have to be supplied by the food for satisfactory nutrition. Therefore there is less chance of feeding an unbalanced protein content by using several feedstuffs, than by using only one or two.

Rations are useful guides in feeding, but it must be noted that the analyses of the feedstuffs from which they are computed are averages only—that is to say, the composition of the feedstuffs varies according to soil and climate wherein grown, and particularly to the age of growth when harvested.

The legumes, such as lucerne, cowpea, clover, &c., are characterised by the high amount of phosphorus and lime (particularly lime) they contain. Therefore, when animals graze on grass pastures growing upon soils deficient in phosphoric acid and lime, the inclusion of a legume in a ration is of particular value to these animals supplying both protein and mineral matter. Bran is also relatively rich in phosphorus.

There is in very many cases a deficiency of phosphoric acid in the pasture grazed by dairy stock. Where such deficiency occurs the rations should be supplemented by the addition of from 2 to 4 oz. of a mixture of finely ground Nauru phosphate and salt. The mixture is in the proportion of two parts by weight of finely ground Nauru phosphate to one part by weight of salt.*

Another consideration is the cost of a particular ration—whether it pays, when it is compared with the price obtained from the milk produced. But care should be taken that blame for unprofitable feeding is not placed upon the ration, when the fault is due to the cow. Some cows are capable of producing a large amount of milk, other cows are only capable of yielding a small amount of milk, even when supplied with ample well-balanced feed; such poor producers do not pay, and should be culled out from the herd.

RATIONS PER 1,000-LB. COW YIELDING 25 LB. MILK.

	Digestible Nutrients.					
	Dry Matter.	Crude Protein.	Fat.	Carbo-hydrates.	Fibre.	Total Digestible Nutrients.	Nutritive Ratio.
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	
1—							
40 lb. Green Sorghum ..	8·0	0·48	0·08	2·32	1·36		
60 lb. Mixed Pasture (average)	12·0	0·53	0·12	3·48	3·01		
8 lb. Lucerne Chaff ..	7·4	1·24	0·05	2·22	0·67		
	27·4	2·25	0·25	8·02	5·04	15·5	1 ÷ 6·0
2—							
65 lb. Green Sorghum ..	13·0	0·78	0·13	3·76	2·14		
7 lb. Lucerne Chaff ..	6·4	1·08	0·04	1·95	0·58		
7 lb. Maize Meal	6·0	0·35	0·21	4·20	0·07		
	25·4	2·21	0·38	9·91	2·79	15·3	1 ÷ 6·1
3—							
45 lb. Green Sorghum ..	9·0	0·54	0·09	2·61	1·49		
13 lb. Wheat Chaff	11·3	0·27	0·12	3·39	2·04		
3 lb. Bran	2·6	0·37	0·05	1·21	0·10		
2¾ lb. Cotton Seed Meal (decorticated)	2·5	0·96	0·17	0·54	0·06		
2 lb. Molasses	1·5	0·02	..	1·15	..		
	27·9	2·16	0·43	8·90	3·69	15·2	1 ÷ 6·2

* Finely-ground steamed Bone-meal can be used instead of Nauru phosphate.

RATIONS FOR DAIRY COWS—*continued.*

RATIONS PER 1,000-LB. COW YIELDING 25 LB. MILK—*continued.*

	Dry Matter.	Digestible Nutrients.				Total Digestible Nutrients.	Nutritive Ratio.
		Crude Protein.	Fat.	Carbo-hydrates.	Fibre.		
	Lb.	Lb.	Lb.	Lb.	Lb.		
4—							
50 lb. Green Sorghum ..	10·0	0·60	0·10	2·90	1·70		
40 lb. Green Cowpea ..	8·8	0·64	0·12	2·92	1·14		
3 lb. Bran	2·6	0·37	0·05	1·21	0·10		
1¾ lb. Cotton Seed Meal (decorticated)	1·6	0·61	0·11	0·34	0·03		
4 lb. Molasses	3·0	0·04	..	2·29	..		
	26·0	2·26	0·38	9·66	2·97	15·3	1 ÷ 5·5
5—							
42 lb. Sorghum Silage ..	10·7	0·38	0·08	3·06	2·06		
9 lb. Lucerne Chaff ..	8·3	1·39	0·06	2·49	0·75		
7 lb. Maize Meal	6·0	0·35	0·21	4·20	0·07		
	25·0	2·12	0·35	9·75	2·88	15·1	1 ÷ 6·3
6—							
35 lb. Sorghum Silage ..	8·9	0·31	0·07	2·55	1·71		
5 lb. Lucerne Chaff ..	4·6	0·77	0·03	1·38	0·42		
6 lb. Wheat Chaff	5·3	0·12	0·05	1·56	0·96		
2 lb. Linseed Oil Meal ..	1·8	0·44	0·15	0·63	0·09		
3 lb. Pollard	2·7	0·41	0·09	1·62	0·06		
3 lb. Rice Meal	2·7	0·20	0·28	1·50	0·06		
	26·0	2·25	0·67	9·24	3·30	15·5	1 ÷ 6·2
7—							
65 lb. Green Maize ..	11·7	0·65	0·19	3·90	2·01		
8 lb. Lucerne Chaff ..	7·4	1·24	0·05	2·22	0·67		
7 lb. Maize Meal	6·0	0·35	0·21	4·20	0·07		
	25·1	2·24	0·45	10·32	2·75	15·7	1¼ ÷ 6·3
8—							
54 lb. Green Maize ..	9·7	0·54	0·16	3·24	1·67		
10 lb. Wheat Chaff	8·7	0·21	0·09	2·61	1·57		
3 lb. Maize Meal	2·6	0·15	0·09	1·80	0·03		
3 lb. Bran	2·6	0·37	0·05	1·21	0·10		
2¾ lb. Cotton Seed Meal (decorticated)	2·5	0·96	0·17	0·54	0·06		
	26·1	2·23	0·56	9·40	3·43	5·6	1 ÷ 6·3
9—							
30 lb. Maize Silage	9·0	0·30	0·09	3·21	1·56		
5 lb. Good Bush Hay ..	4·6	0·14	0·03	1·20	1·13		
4 lb. Cowpea Chaff ..	3·6	0·45	0·07	0·76	0·54		
5 lb. Maize Meal	4·4	0·25	0·15	3·00	0·05		
3 lb. Cocoanut Cake ..	2·6	0·40	0·21	1·19	0·20		
1 lb. Blood Meal	0·9	0·67	0·01	0·05	..		
	25·1	2·21	0·56	9·41	3·48	15·6	1 ÷ 6·4

RATIONS FOR DAIRY COWS—*continued.*

RATIONS PER 1,000-LB. COW YIELDING 25 LB. MILK—*continued.*

—	Dry Matter.	Digestible Nutrients.				Total Digestible Nutrients.	Nutritive Ratio.
		Crude Protein.	Fat.	Carbo-hydrates.	Fibre.		
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	
10—							
35 lb. Maize Silage ..	10·5	0·35	0·10	3·75	1·82		
8 lb. Lucerne Chaff ..	7·4	1·24	0·05	2·22	0·67		
7 lb. Barley Meal	6·2	0·65	0·06	4·27	0·21		
	24·1	2·24	0·21	10·24	2·70	15·4	1 ÷ 6·0
11—							
80 lb. Green Paspalum ..	20·0	1·20	0·16	5·60	4·96		
6 lb. Lucerne Chaff ..	5·5	0·93	0·04	1·67	0·50		
	25·5	2·13	0·20	7·27	5·46	15·0	1 ÷ 1·6
12—							
67 lb. Green Paspalum ..	16·5	1·00	0·13	4·69	4·15		
3 lb. Maize Meal	2·6	0·15	0·09	1·80	0·03		
3 lb. Bran	2·6	0·37	0·05	1·21	0·10		
2 lb. Cotton Seed Meal (decorticated)	1·8	0·70	0·13	0·39	0·04		
	23·5	2·22	0·40	8·09	4·32	15·0	1 ÷ 6·0
13—							
100 lb. Sudan Grass	22·0	1·50	0·10	7·50	3·80		
4½ lb. Lucerne Chaff ..	4·1	0·70	0·03	1·25	0·37		
	26·1	2·20	0·13	8·75	4·17	15·3	1 ÷ 6·0
14—							
100 lb. Sudan Grass	22·0	1·50	0·10	7·50	3·80		
3 lb. Bran	2·6	0·37	0·05	1·21	0·10		
1 lb. Cotton Seed Meal (decorticated)	0·9	0·35	0·07	0·19	0·02		
	25·5	2·22	0·22	8·90	3·92	15·3	1 ÷ 6·0
15—							
50 lb. Sudan Grass	11·0	0·75	0·05	3·75	1·90		
8 lb. Wheat Chaff	7·0	0·16	0·07	2·09	1·29		
4 lb. Lucerne Chaff ..	3·7	0·62	0·02	1·11	0·33		
3 lb. Maize Meal	2·6	0·15	0·09	1·80	0·03		
2 lb. Linseed Oil Meal ..	1·8	0·44	0·15	0·63	0·09		
	26·1	2·12	0·38	9·38	3·64	15·5	1 ÷ 6·5
16—							
20 lb. Green Oats	4·6	0·28	0·08	1·30	0·98		
8 lb. Lucerne Chaff ..	7·4	1·24	0·05	2·22	0·67		
10 lb. Wheat Chaff	8·8	0·21	0·09	2·61	1·61		
3 lb. Cocoanut Cake ..	2·6	0·40	0·22	1·19	0·20		
3 lb. Molasses	2·3	0·03	..	1·72	..		
	25·7	2·16	0·45	9·04	3·46	15·1	1 ÷ 6·3

RATIONS FOR DAIRY COWS—*continued.*

Rations per 1,000-lb. Cow Yielding 25 lb. Milk—*continued.*

	Dry Matter.	Digestible Nutrients.				Total Digestible Nutrients.	Nutritive Ratio.
		Crude Protein.	Fat.	Carbo-hydrates.	Fibre		
17—	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	
25 lb. Green Barley	5·2	0·45	0·10	1·50	1·07		
13 lb. Wheat Chaff	11·4	0·27	0·11	3·40	2·10		
6 lb. Lucerne Chaff ..	5·5	0·93	0·04	1·67	0·50		
2 lb. Linseed Oil Meal ..	1·8	0·44	0·15	0·63	0·09		
3 lb. Molasses	2·3	0·03	..	1·72	..		
	26·2	2·12	0·40	8·92	3·76	15·2	1 ÷ 6·4
18—							
60 lb. Sugar-cane Tops ..	16·8	1·02	0·18	5·64	3·90		
10 lb. Cowpea Chaff ..	9·2	1·12	0·19	1·90	1·35		
	26·0	2·12	0·37	7·54	5·25	15·3	1 ÷ 6·4
19—							
50 lb. Sugar-cane Tops ..	14·0	0·85	0·15	4·70	3·25		
30 lb. Green Cowpea ..	6·6	0·48	0·09	2·19	0·84		
5 lb. Lucerne Chaff ..	4·6	0·77	0·04	1·38	0·42		
	25·2	2·10	0·28	8·27	4·51	15·2	1 ÷ 6·3
20—							
35 lb. Elephant Grass ..	7·0	0·32	0·07	2·03	1·75		
35 lb. Imphee	7·0	0·42	0·07	2·03	1·15		
8 lb. Lucerne Chaff ..	7·4	1·24	0·05	2·22	0·67		
5 lb. Maize Meal	4·4	0·25	0·15	3·00	0·05		
	25·8	2·23	0·34	9·28	3·62	15·5	1 ÷ 6·1
21—							
35 lb. Elephant Grass ..	7·0	0·32	0·07	2·03	1·75		
35 lb. Imphee	7·0	0·42	0·07	2·03	1·15		
10 lb. Pumpkins	1·7	0·15	0·06	0·80	0·16		
7 lb. Lucerne Chaff ..	6·4	1·08	0·04	1·95	0·58		
5 lb. Maize Meal	4·4	0·25	0·15	3·00	0·05		
	26·5	2·22	0·39	9·81	3·69	16·1	1 ÷ 6·4
22—							
65 lb. Mixed Pasture (average)	13·0	0·57	0·13	3·77	3·26		
9 lb. Lucerne Chaff ..	8·3	1·39	0·05	2·50	0·75		
5 lb. Maize Meal	4·4	0·25	0·15	3·00	0·05		
	25·7	2·21	0·33	9·27	4·06	15·8	1 ÷ 6·3
23—							
15 lb. Poor Bush Hay ..	14·0	0·21	0·08	2·77	3·03		
10 lb. Pumpkins	1·7	0·15	0·06	0·80	0·16		
5 lb. Lucerne Chaff ..	4·6	0·77	0·03	1·38	0·42		
7 lb. Maize Meal	6·1	0·35	0·21	4·20	0·07		
1 lb. Blood Meal	0·8	0·66	0·02	0·06	..		
	27·2	2·14	0·40	9·21	3·68	15·4	1 ÷ 6·4
24—							
65 lb. Prairie Grass ..	15·1	1·95	0·26	4·29	2·75		
5 lb. Wheat Chaff	4·4	0·10	0·04	1·30	0·80		
5 lb. Maize Meal	4·4	0·25	0·15	3·00	0·05		
1 lb. Molasses	0·7	0·01	..	0·57	..		
	24·6	2·31	0·45	9·16	3·60	15·5	1 ÷ 5·9

It has been mentioned before that better results are obtained from rations composed of a variety of feed ingredients than from a ration made up with only one or two feedstuffs.

A very convenient method is to have on hand a quantity of the concentrates already mixed, and then to feed a certain quantity of this mixture with the roughage that is being used, increasing the quantity of the mixture used until it is noticed that no further increased milk production is obtained. An example of this procedure has been published in the "Live Stock Bulletin" under the heading of "4-2-1" plan; this meaning that a concentrate mixture is made of four parts maize meal, two parts ground oats, and one part linseed meal. The above mentioned paper recommends the following:—3 lb. of silage and 1 lb. of legume hay for every 100 lb. of the animal's body weight, and to gradually increase the amount given of the concentrate mixture until the cow is getting 1 lb. for every 5 lb. of milk produced. Thus a 1,000-lb. cow, yielding 25 lb. of milk, would be given a ration of 30 lb. maize silage, 10 lb. lucerne hay, and 5 lb. of the concentrate mixture—containing 2.26 lb. digestible crude protein and 13.6 lb. total digestible nutrients. This ration has the amount of digestible crude protein required by the Henry and Morrison standard, but has a somewhat lower amount of total digestible nutrients. Other concentrates can be used in this convenient manner.

For instance, a concentrate mixture could be prepared by mixing eight parts maize meal, one part bran, and one part cotton seed meal. This mixture would have the following composition:—

	Dry Matter.	Digestible.			
		Crude Protein.	Fat.	Carbo-hydrates.	Fibre.
	Lb.	Lb.	Lb.	Lb.	Lb.
1 lb. Concentrate Mixture	0·87	0·088	0·032	0·539	0·014
5 lb. Concentrate Mixture	4·3	0·44	0·16	2·69	0·07

If 4 lb. maize silage and 1 lb. lucerne chaff be used for every 100 lb. live weight, and 1 lb. of the above concentrate mixture for every 5 lb. of milk produced, the following will be the ration for a 1,000 lb. cow yielding 25 lb. of milk:—

	Dry Matter.	Digestible.				Total Digestible Nutrients.	Nutritive Ratio.
		Crude Protein.	Fat.	Carbo-hydrates.	Fibre.		
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	
40 lb. Maize Silage	12·0	0·40	0·12	4·27	2·08		
10 lb. Lucerne Chaff	9·2	1·55	0·07	2·77	0·84		
5 lb. Concentrate Mixture ..	4·3	0·44	0·16	2·69	0·07		
	25·5	2·39	0·35	9·73	2·99	15·5	1 ÷ 5·6

The amount of digestible crude protein is a little higher in this ration than is required by the standard.

The following extracts from the "Agricultural Gazette" of New South Wales, December, 1927, are given as an illustration of what complete feeding, when combined with high milk-producing power, can accomplish:—

"On 15th October, 1927, Wagga Gladys, the seven-year old Jersey cow of the Hawkesbury Agricultural College herd, completed 365 days' official test for a yield of 20,835 lb. milk, with an average test of 5.52 per cent. and 1,149,385 lb. butter fat, which is equivalent to 1,384.8 lb. commercial butter. This is an official world's record for both milk and butter fat production for the Jersey breed. It was achieved on twice-a-day milking, whereas all the great records in other countries have been made on three and four milkings a day. Wagga Gladys calved on 9th November, 1926, and on the day of her last periodical test she yielded 53.5 lb. milk and 3.694 lb. butter fat in twenty-four hours."

The following is extracted from the "Agricultural Gazette" of New South Wales, October, 1927, and shows the ration fed to Wagga Gladys, together with the record of her 273 days' performance:—

"On her present lactations as a seven year-old, which is still in progress, she has produced for the first nine-months period 15,951 lb. milk, of 5.3 per cent. test, 839,814 lb. butter fat, being equal to 1,011.8 lb. commercial butter. . . . On the hypothesis that feeding must be linked with breeding to secure high production, an indication of the ration fed to Wagga Gladys may be given.

"*Concentrates.*—The following mixture was fed daily at the rate of 1 lb. to every 3½ lb. milk produced:—300 lb. maize meal, 200 lb. bran, 100 lb. crushed oats, 50 lb. linseed meal. During March and April the mixture was altered by the substitution of 25 lb. cotton seed meal for 25 lb. of the linseed meal.

"*Bulk Ration.*—The daily bulk ration consisted of:—25 lb. maize silage, 10 lb. lucerne chaff (of poor quality during May), 3 lb. bran, and 1½ lb. linseed meal. During March and April half the linseed meal was replaced by an equal amount of cotton seed meal. During the latter half of the month of March the silage was replaced by an equal amount of green corn stalks chaffed.

"*Grazing.*—The pastures were very poor, except after the Easter rain. In December, Wagga Gladys was grazed on a poor stand of green lucerne for two days prior to test. In January, she was grazed on green lucerne for two hours daily for a week previous to test. In February, March, and April, she was grazed on green lucerne for two hours daily, and in May and June for one hour daily. In July, green oats were given for a week previous to the test; Gladys and the whole herd went off in butter fat yield this month, and the green oats were blamed. In August, she was grazed on green lucerne for two hours daily."

It will be interesting to compare the abovementioned cow's milk production and her feeding with the standard used in computing the examples of rations previously given. The weight of Wagga Gladys is not known, and though it may not be 1,000 lb. live weight, this figure will be used for the sake of comparison.

The cow produced 15,951 lb. milk in 273 days—that is, 58.4 lb. of milk per day, of 5.3 per cent. fat. Using the minimum requirements of the standard, the cow should receive 4.32 lb. digestible crude protein and 29.7 total digestible nutrients.

The cow produced on an average 58.4 lb. of milk per day, and it is stated that for every 3½ lb. of milk produced 1 lb. of the mixed concentrate was given; therefore, 16.6 lb. mixed concentrate was fed daily. The following is the total ration fed:—

	Dry Matter.	Digestible Nutrients.				Total Digestible Nutrients.	Nutritive Ratio.
		Crude Protein.	Fat.	Carbo-hydrates.	Fibre.		
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	
Bulk Ration—							
25 lb. Maize Ensilage ..	7·5	0·25	0·07	2·67	1·30		
10 lb. Lucerne Chaff ..	9·2	1·55	0·07	2·77	0·84		
3 lb. Bran	2·6	0·37	0·05	1·21	0·10		
1·5 lb. Linseed Meal ..	1·3	0·33	0·11	0·47	0·06		
16·6 lb. Mixed Concentrate	14·6	1·50	0·52	8·20	0·37		
	35·2	4·00	0·82	15·32	2·67	22·8	1 ÷ 4·9
Allowing 10 lb. Green Lucerne for one hour's grazing ..	2·4	0·32	0·04	0·63	0·29		
	37·6	4·32	0·86	15·95	2·96	24·0	1 ÷ 4·8
Or—							
Allowing 20 lb. Green Lucerne for two hours' grazing ..	4·8	0·64	0·08	1·26	0·58		
	40·0	4·64	0·90	16·58	3·25	25·4	1 ÷ 4·7

It will be seen that the digestible crude protein, 4.32 lb., agrees with that required by the standard, and that the amount of total digestible nutrients of this ration is somewhat lower.

PRODUCTION RECORDING.

List of cows officially tested by officers of the Department of Agriculture and Stock which have qualified for entry into the Advanced Register of the Herd Book of The Australian Illawarra Shorthorn Society, The Jersey Cattle Society, The Ayrshire Herdbook of Queensland, and the Friesian Herd Book of Australia. The final tests of these cows were carried out during the months of May and June, 1931 (273 days' period unless otherwise stated.)

Name of Cow.	Age.	Milk Production.	Butter Fat.	Owner.
		Lb.	Lb.	
JERSEY.				
Lady Dorothy of Carlton	Mature	12,009·597	649·861	J. Collins, Tingoora
Trecarne Duchess	Mature	9,534	551·779	T. A. Petherick, Lockyer
Melrose Countess	Mature	7,806·75	434·467	J. W. Evans, Boonah
Oxford Mousie	Mature	8,214	428·588	G. S. Beckett, Boonah
Trinity Hazelette	Mature	7,996·25	422·052	J. Sinnamon and Sons, Moggill
Sultans Rosella of Brooklands	Mature	7,797·169	387·645	T. A. Petherick, Lockyer
Duchess of Woodlands	Senior (4 years)	7,863·125	365·516	D. R. Hutton, Cunningham
Trecarne Rosella	Junior (4 years)	7,154·873	469·848	T. A. Petherick, Lockyer
Trinity Bubbles	Junior (4 years)	8,749·25	421·434	J. Sinnamon and Sons, Moggill
Trecarne Tottie 4th	Junior (4 years)	5,844·9	382·761	H. Mear, Maleny
Pansy of Woodlands	Senior (3 years)	8,250·375	383·687	D. R. Hutton, Cunningham
Yimmin Crystal	Senior (3 years)	6,198·9	323·441	Burton and Co., Yandina
Viscounts Milkmaid of Woodbine	Senior (3 years)	5,539·25	294·307	F. P. Fowler and Sons, Coalstoun Lakes
Trinity Gloria	Junior (3 years)	7,766·375	431·492	J. Sinnamon and Sons, Moggill
Ruby of Carlton	Junior (3 years)	7,919·933	395·639	J. Collins, Tingoora
Trecarne Locket	Junior (3 years)	5,995·821	328·788	T. A. Petherick, Lockyer
Sweet Zinnie of Chelsford	Junior (3 years)	5,134·075	282·402	G. A. Ferguson, Woodhill
Gleam of Ipsley (300 days)	Senior (2 years)	6,278·5	385·493	J. A. Rudd, Corinda
Dot of Ipsley	Senior (2 years)	6,139·825	364·598	J. A. Rudd, Corinda
Princess 3rd of Ferndale	Senior (2 years)	6,642·125	332·794	D. R. Hutton, Cunningham
Oxford Palatine Dot	Senior (2 years)	4,755·05	295·428	V. Goodger, Nanango
Baby of Burnleigh	Senior (2 years)	5,656·85	292·461	W. W. Mallett, Nambour
Trecarne Flora 3rd	Senior (2 years)	5,317·785	289·505	T. A. Petherick, Lockyer
Abbeystead Pride	Senior (2 years)	5,864·632	281·202	J. C. Davey, Gatton
Primrose of Burnleigh	Senior (2 years)	4,273·75	255·885	C. F. Klaus, Mundubbera
Trinity Meadowsweet	Junior (2 years)	6,478·125	385·043	J. Sinnamon and Sons, Moggill
Trinity Augustine	Junior (2 years)	6,828·125	379·702	J. Sinnamon and Sons, Moggill
Trinity Crystal	Junior (2 years)	6,907·125	350·929	J. Sinnamon and Sons, Moggill
Pineview Model	Junior (2 years)	5,847·05	343·925	J. Hunter and Sons, Borallon
Trinity Dreamaway	Junior (2 years)	6,547·625	331·863	J. Sinnamon and Sons, Moggill
Una of Wavemere	Junior (2 years)	5,302·25	330·44	Mrs. L. M. Dahl, Taragoola
Mayflower of Lisieux	Junior (2 years)	5,866·853	321·09	J. Williams, Greenview
Trinity Harmony	Junior (2 years)	6,033	320·381	J. Sinnamon and Sons, Moggill
Melody of Rosehill	Junior (2 years)	5,273	306·283	T. Gillespie, Ravenshoe
Charm of Burnleigh	Junior (2 years)	4,826·05	281·325	W. W. Mallett, Nambour
Kenmore Peacetime	Junior (2 years)	5,546·425	278·254	E. L. Melville, Toogoolawah
Girlies Fair Luck of Highthorn	Junior (2 years)	4,936·4	273·406	J. F. Teske, Nambour
Trecarne Tottie 5th	Junior (2 years)	3,504·123	268·502	T. A. Petherick, Lockyer
Blue Belle of Burnleigh	Junior (2 years)	4,688·15	251·936	W. W. Mallett, Nambour
Trecarne Rosebud	Junior (2 years)	4,197·961	232·444	T. A. Petherick, Lockyer
AUSTRALIAN ILLAWARRA SHORTHORN.				
Foremost of Blacklands	Mature	16,193·296	615·543	A. Pickels, Wondai
Roan 4th of Oakvilla	Mature	11,562·458	460·634	W. Marquardt, Wondai
Betty 2nd of Iroquois	Mature	9,680·667	427·795	H. Welch, Proston
Maggie 3rd of Rockleigh	Mature	9,125·601	418·153	T. Strain, Wondai
Ready of Bri Bri	Mature	10,064	389·513	W. Middleton, Cambooya
Pet of Hill Top	Mature	9,293·272	381·679	J. A. Heading, Cloyna
Maisy of Nestles	Mature	9,378·45	367·511	C. Francis, Biarra
Poppy of Hill Top	Mature	11,111·291	365·674	J. A. Bradley, Goomeri
Daly of Rhodesview	Mature	9,998·121	357·289	W. Gierkie and Sons, Helidon
Princess of Rockleigh	Mature	8,639·216	351·355	T. Strain, Wondai
Nancy of Hill Top	Mature	9,346·53	377·666	J. A. Heading, Cloyna
Cherry 7th of Rosemount	Senior (4 years)	9,875·05	385·45	A. J. Bryce, Maleny
Doreen 9th of Rosemount	Senior (4 years)	8,514·05	345·413	A. J. Bryce, Maleny
Red Plum 7th of Springdale	Senior (4 years)	9,955·5	335·276	T. Shuttlewood, Peachester
Duchess of Wadevale	Junior (4 years)	11,632·3	593·361	J. Wade, Kilcoy
Topsy of Waverley	Junior (4 years)	11,553	427·462	V. Dunstan, Wolvi
Stella 6th of White Park	Junior (4 years)	9,491·875	371·148	W. T. Savage, Barnesmore
Princess II. of White Park	Junior (4 years)	7,943·75	341·665	W. T. Savage, Barnesmore
Model 17th of Springdale	Junior (4 years)	9,922·2	331·72	T. Shuttlewood, Peachester
Pansy of Corunna	Junior (4 years)	8,132·5	310·03	C. O'Sullivan, Ascot Factory
Lady Sal IX. of Cedar Grove	Senior (3 years)	8,177·85	380·813	A. C. Stewart, Gympie
Rosebud 9th of Rosenthal	Senior (3 years)	8,863	357·996	S. Mitchell, Rosenthal
Charm 2nd of Wilga Vale	Senior (3 years)	9,261·625	346·086	C. O'Sullivan, Ascot Factory
Peggy of Glenrock	Senior (3 years)	9,025·125	319·237	A. Kamholtz, Nerang
Alice 14th of Kingsdale	Senior (3 years)	7,708·8	311·368	A. A. King, Mooloolah
Empress 5th of Lemon Grove	Junior (3 years)	10,076·95	398·589	Mrs. A. M. Bowman, Kin Kin
Rose Marie of Dnalwon	Junior (3 years)	7,337·123	276·994	A. J. Caswell, Wangalpong

PRODUCTION RECORDING—*continued.*

Name of Cow.	Age.	Milk Production.	Butter Fat.	Owner.
		Lb.	Lb.	
AUSTRALIAN ILLAWARRA SHORTHORNS—*continued.*				
Princess 2nd of Headlands ..	Senior (2 years)	10,345·286	424·987	J. A. Heading, Cloyna
Scarlet XII. of Springdale ..	Senior (2 years)	10,051·05	390·212	V. Dunstan, Wolvi
Beauty 15th of Fairlie ..	Senior (2 years)	8,950·75	382·111	C. B. Mitchell, Warwick
Dahlia 7th of Springdale ..	Senior (2 years)	10,058·275	379·215	A. J. Caswell, Wangalpong
Butterfly of Trevor Hill ..	Senior (2 years)	8,742·25	371·803	G. Gwynne, Umbiram
Favourite of Doctor's Creek ..	Senior (2 years)	8,477·6	344·832	A. E. Vohland, Aubigny
Lovely 10th of Greyleigh ..	Senior (2 years)	8,729·3	327·146	W. H. Thompson, Nanango
Blossom 4th of The Cedars ..	Senior (2 years)	8,885·181	299·213	M. C. Lester, Laidley Creek
Dulcie 9th of Kingsdale ..	Senior (2 years)	7,207·05	287·32	A. A. King, Mooloolah
Doreen 14th of Rosemount ..	Senior (2 years)	6,887·95	277·471	A. J. Bryce, Maleny
Alice 19th of Kingsdale ..	Senior (2 years)	6,442·55	259·342	A. A. King, Mooloolah
Susie 5th of Nestlebrae ..	Senior (2 years)	7,347·45	255·163	A. A. King, Mooloolah
Dairymaid of Dnalwon ..	Junior (2 years)	9,020	363·903	E. F. Thompson, Tallebudgera
Olive 12th of Cedar Grove ..	Junior (2 years)	9,032·5	335·305	C. O'Sullivan, Greenmount
Fluff of Dnalwon	Junior (2 years)	8,270·75	318·993	R. L. Harrison, Gleneagle
Sunflower of Green Hill ..	Junior (2 years)	8,707·478	310·349	J. W. Johnston, Wooroolin
Venus 6th of Euroa	Junior (2 years)	7,542	296·693	H. F. Lindenmayer, Mundubbera
Duchess 4th of Homelea (272 days)	Junior (2 years)	6,938	280·937	J. Savage, Humphrey
Mayflower 11th of Parkview	Junior (2 years)	6,944·625	256·480	Queensland Agricultural High School and College, Gatton
Gentle 2nd of Mountain Home	Junior (2 years)	6,934·505	246·728	M. C. Lester, Laidley Creek
Floss of Parkview	Junior (2 years)	4,276·693	240·52	Queensland Agricultural High School and College, Gatton
College Fussy	Junior (2 years)	6,203·434	231·443	Queensland Agricultural High School and College, Gatton
FRIESIAN.				
Dot II. of Oaklands	Mature ..	10,878·267	403·693	W. Richters, Tingoora
Dairymaid II. of Oaklands ..	Mature ..	10,032·457	381·546	W. Richters, Tingoora
Stoneybrae Belle	Junior (2 years)	11,155·5	411·935	Hickey and Sons, Wilston
Glendalough Queen	Senior (2 years)	11,053	381·264	Hickey and Sons, Wilston
Oaklands Rock Girl	Junior (3 years)	8,596·469	319·567	W. Richters, Tingoora
AYRSHIRES.				
Fairview Orphan Girl ..	Mature ..	11,519·925	424·115	J. H. and R. Anderson, Southbrook
Longlands Fuschia	Mature ..	9,903·6	382·19	T. Holmes, Yarranlea
Fairview Pride	Junior (4 years)	8,028·45	348·114	J. H. and R. Anderson, Southbrook
Fairview Lady Jean	Junior (4 years)	7,793·975	328·083	J. H. and R. Anderson, Southbrook
Benbecula Thelma	Junior (3 years)	9,668·45	375·427	T. Holmes, Yarranlea
Longlands Tina VII.	Junior (3 years)	9,053·6	312·999	T. Holmes, Yarranlea
Benbecula Berry	Junior (3 years)	7,664·9	288·005	T. Holmes, Yarranlea
Benbecula Laurel	Senior (2 years)	7,173·7	250·954	T. Holmes, Yarranlea

List of cows, officially tested by officers of the Department of Agriculture and Stock, which have qualified for entry into the Advanced Register of the Herd Book of The Australian Illawarra Shorthorn Society, The Jersey Cattle Society, The Friesian Cattle Society of Australia, and The Ayrshire Cattle Society. Production charts for which were compiled during the months of September and to the 20th October, 1931 (273 days' period unless otherwise stated).

Name of Cow.	Age.	Milk Production.	Butter Fat.	Owner.
		Lb.	Lb.	
AUSTRALIAN ILLAWARRA SHORTHORNS.				
Glenlee Moreen	Mature ..	11,077·4	476·106	R. Martin, Coulstoun Lakes
Fanny 3rd of Rhodesview ..	Mature ..	9,564·882	352·047	W. Gierke and Sons, Helidon
Redwing 10th of Strathobi ..	Senior (4 years)	9,604·85	354·135	A. C. Stewart, Kin Kin
Duchess 5th of Beechwood ..	Senior (3 years)	7,977·55	331·463	A. Marks, Atherton
Carnation of Trevor Hill ..	Junior (3 years)	7,998·374	327·981	G. Gywnne, Southbrook
Dove 13th of Rosenthal ..	Junior (3 years)	7,854·75	327·348	S. Mitchell, Warwick
Rosetta 14th of Burradale ..	Senior (2 years)	9,832·625	393·764	W. F. Kajewski, Glencoe
Angeline 3rd of Bri Bri (268 days)	Senior (2 years)	7,004·6	359·094	W. Middleton, Cambooya

PRODUCTION RECORDING—*continued.*

Name of Cow.	Age.	Milk Production.	Butter Fat.	Owner.
		Lb.	Lb.	
AUSTRALIAN ILLAWARRA SHORTHORNS—*continued.*				
Fuschia 8th of Rosenthal ..	Senior (2 years)	7,426·375	297·66	S. Mitchell, Warwick
Persia 4th of Rosenthal ..	Senior (2 years)	7,115·5	292·981	S. Mitchell, Warwick
Tiny 3rd of Rhodesview ..	Senior (2 years)	8,065·63	289·356	W. Gierkie and Sons, Helidon
Minnie of Happy Valley ..	Senior (2 years)	6,255·35	277·743	R. Martin, Coalstoun Lakes
Kittie 2nd of Kingsdale ..	Senior (2 years)	6,490·95	277·066	A. A. King, Mooloolah
Blossom 2nd of Oakvilla ..	Junior (2 years)	9,246·914	361·148	H. Marquardt, Wondai
Chance of Wandegong ..	Junior (2 years)	8,676·25	345·549	F. D. Lindenmayer, Mundubbera
Mavis of Thornhill (262 days)	Junior (2 years)	7,054	292·384	R. Chalmers, Mundubbera
Princess of Wandegong ..	Junior (2 years)	7,030·25	290·926	G. D. Lindenmayer, Mundubbera
Velvet of Trevor Hill ..	Junior (2 years)	6,822·7	283·949	G. Gwynne, Southbrook
Queenie 8th of Rhodesview ..	Junior (2 years)	6,925·965	277·758	W. Gierkie and Son, Helidon
Fuschia of Trevor Hill ..	Junior (2 years)	6,667·7	271·026	G. Gwynne, Southbrook
College Wonga	Junior (2 years)	5,573·038	242·587	Queensland Agricultural High School and College, Gatton
College Stately	Junior (2 years)	5,221·5	233·8	Queensland Agricultural High School and College, Gatton
JERSEY.				
Trinity Royal Rosie	Mature ..	8,332·875	447·204	J. Sinnamon and Sons, Moggill
Jerseymaid of Burnleigh ..	Mature ..	6,430·3	424·833	R. A. Anderson, Yandina
Treasure of Burnleigh ..	Junior (4 years)	6,921·05	341·757	W. W. Mallett, Nambour
Carnation Charm's Star ..	Junior (3 years)	6,070·75	340·824	H. Neil, Brassall
Yimmin Queen	Senior (2 years)	5,750·7	331·942	Burton and Sons, Yandina
Peerless of Southport ..	Junior (2 years)	7,489·512	373·377	J. Collins, Tingoora
Desert Maid of Brooklands ..	Junior (2 years)	7,093·226	365·601	J. Williams, Wondai
Trinity National Lady ..	Junior (2 years)	6,630·75	346·03	J. Sinnamon and Sons, Moggill
Majesty's Joan of Brooklands	Junior (2 years)	6,493·092	296·084	J. Williams, Wondai
Glenview Skylight	Junior (2 years)	4,810	270·134	F. P. Fowler and Sons, Coalstoun Lakes
Gladness of Hamilton ..	Junior (2 years)	4,044·75	240·868	J. W. Evans, Boonah
Goldfinder's Honeysuckle of Morago	Junior (2 years)	4,259·5	234·755	J. W. Evans, Boonah
FRIESIAN.				
Stella Rock of Oaklands ..	Junior (2 years)	8,271·227	298·261	W. Richters, Tingoora
Rock Maid of Oaklands ..	Junior (2 years)	7,601·135	286·571	W. Richters, Tingoora
Fanny Rock of Oaklands ..	Junior (2 years)	7,224·227	276·357	W. Richters, Tingoora
AYRSHIRE.				
Crescent Farm Beryl's Pride (261 days)	Mature ..	11,271·515	437·196	J. C. Mann, Yarranlea
Crescent Farm Choice.. ..	Senior (3 years)	9,428·998	361·823	J. C. Mann, Yarranlea
Crescent Farm Vixen	Junior (2 years)	9,486·08	382,672	J. C. Mann, Yarranlea

TRYPAN BLUE.

A SPECIFIC FOR BUSH TICK PARALYSIS.

Where scrub or bush ticks are suspected as being responsible for paralysis in pigs, it is recommended that, particularly in the case of valuable animals and where scrub ticks are prevalent, the animals should be thoroughly examined every second or third day, as it has been stated that these ticks do not harm the animals during the first four days of attachment.

It has been proved that trypan blue, injected under the skin is a specific (or a suitable remedy) for this disease in the dog, for under careful treatment, the paralysis soon improves and in a few days the animal thoroughly recovers, one dose of the trypan blue usually being sufficient.

Preparation of Solution.—A 2 per cent. solution (about nine grains to the fluid ounce) is made by dissolving the trypan blue in boiling water, a sediment falling as the solution cools, and this should be removed by filtering through a funnel in which a properly folded filter paper is placed, or a fine piece of clean linen which has been previously boiled. The hypodermic syringe and needle, necessary in this form of treatment, before being used should be placed in a vessel containing cold water, then placed over the fire and the water boiled for ten minutes; this to thoroughly sterilize the syringe and needle which is now ready for use when the solution to be injected has cooled.

The injection can be made anywhere under the skin, but the best positions are either in the front of the chest or behind the shoulder, the skin in these positions being loose a fold of which is easily caught up by the fingers of the left hand, whilst the needle is inserted with the right hand. It is advisable to clip off the hair and disinfect the spot chosen before introducing the needle.

A dose for dogs, according to age and size, varies from 1 to 5 drachms, or 1 to 5 teaspoonfuls; the dose for calves, foals, and pigs according to age and size from ½ ounce to 2½ ounces or 1 to 5 tablespoonsful.

In general it would be preferable for the pig-raiser to have the solution prepared by a chemist to ensure accuracy of preparation and dosage.

ERADICATION OF DISEASE AMONG PIGS.

By J. A. RUDD, L.V.Sc., Department of Agriculture and Stock, Brisbane.

THE eradication of tuberculosis and other diseases in pigs is not difficult if certain very definite lines are followed to that end. The question arises: How does the pig become infected? It is undoubtedly manifest that there are several channels through which infection may be carried to the pig.

(1) Through transmission from parent to offspring.
(2) From milk and other dairy slops.
(3) The use of insanitary feeding troughs and general unclean condition of sties, and faulty methods of construction of sties so that it is a matter of impossibility to keep them clean and wholesome.

Hereditary Transmission.

Transmission from parent to offspring although possible is not a very constant source of infection, and may be dismissed with the observation that all things being equal there is in reality very little chance of infection from this source.

The Bucket.

Milk and other dairy slops are one of the chief sources of infection. Dairy cows all the world over suffer from tuberculosis. At least 2 per cent. of the cows of most herds are liable to spread infection through their milk supply, i.e., they have or are affected with tuberculosis of the udder, and unless this 2 per cent. at least are eliminated the chances of infection are very great. The elimination of this 2 per cent. is not a difficult matter, and it only requires the exercise of a certain amount of intelligence in order to do this successfully. Assuming that this 2 per cent. cannot for various reasons be cut out of the active list of the herd, the other method is to cook the skim milk before feeding it to the pigs. Raising a temperature of 155 deg. Fahr. for fifteen minutes will do all that is required, and not only the pigs but also calves will have the added advantage of being fed on milk which is not only very wholesome but absolutely free from disease. This is not a big undertaking and should be carried out purely as a routine practice, as it eliminates the germs of contagious mastitis, tuberculosis, and contagious abortion in one hit, and also a great many of the so-called diseases of young calves which are largely due to unclean methods of milking and treatment of milk after separation of the cream from the skim milk. The return as a result of immunity from disease will more than repay the added cost of the additional work necessary in order to insure immunity among the small immature stock on the farm.

Filth.

The use of insanitary feeding troughs and general unclean condition of sties and faulty methods of construction of sties make it a matter of impossibility to keep them clean and wholesome.

It is possible to obtain a culture of bovine tuberculosis and other bacilli from the cracks in the end of wooden feeding troughs. If these cracks or crevices are capable of holding such filth it is clearly an impossibility to breed healthy pigs.

If wooden troughs are an absolute necessity, then why not fill up the cracks and crevices with cement and clean them once every week with a strong solution of washing soda? There are certain woods which do not split and crack easily, such, for instance, as the mahogany which, although it will not stand in the ground, is

used largely for piles in rivers where borers are prevalent. The erection of suitable pens with impervious concrete floors are an absolute necessity if disease is to be held in check.

The insanitary condition of pig pens. From their construction one is led to think that sanitation was not considered necessary and did not enter into the calculation of those who are responsible for such death traps. Slabbed floors raised off the ground through which excreta and products of decomposing vegetable and animal matter percolates on to the ground below and accumulating there for years is a common spectacle on most pig farms. The pig is securely enclosed in this sty, meticulous care being taken to make sure that all avenues of likely escape from such evil looking and filthy surroundings are completely cut off, with the result that he has to live his normal life surrounded on all sides by a cesspool of iniquitous fermenting filth, the gases from which escaping continuously not only make life a perfect nightmare but must of necessity breed disease, the result of which is only discovered when the returns from the factory disclose the fact. This specious form of cruelty should be discontinued if healthy pigs are to be bred, both for pleasure and for profit.

The Normal Pig.

Given healthy surroundings the pig is normally a hardy, thrifty animal and one that can be depended on easily to make the greatest profit out of the poorest food in comparison with other farm animals.

Breeding from healthy stock which are not inbred does help not only in early maturity but in keeping down disease. The pig is one of the few animals that will not stand inbreeding and whose constitution quickly resents any tricks in this direction. Breeding from immature stock, and this also includes promiscuous breeding, is a factor which cannot be too lightly regarded if success is to be assured in the breeding of pigs for profit.

Selection in Breeding.

The selection of breeding stock is not always attended to with the care that is necessary to guard against predisposition to disease. Knocked-kneed, swampy backed boars and sows of similar conformation with the additional defect that they are down on their pins (i.e., weak fetlocks) are commonly seen among the breding stock, with the result that these animals can easily be responsible for a great many of the ills attendant on immature young stock. "Like begets like" is one of the fundamental principles of breeding. This is a golden rule and is generally well known, but it is more often accepted and carried out in the breach than in the observance. So much depends also on the feeding of the parents not only after the pigs are born and still sucking their mother but before there is even a thought of breeding from her. The feeding of the boar is likewise as important, and neglect in this regard is responsible for so many failures—80 per cent. of the partial paralysis of pigs is bred into them by unsuitable mating of faulty parents and with such faults as are easily seen and could be quickly corrected by sterilisation of the unfit. If this was a difficult matter it might easily be overlooked, but as it is one of the everyday operations on the farm lack of care may easily account for a good deal of latent trouble, which manifests itself as time goes on, and the price paid for such neglect is altogether out of all proportion and makes all the difference betwen profit and loss. There is still another matter which is suggested for serious consideration, and that is the methods which may be adopted with the object of ridding the herd of the 2 per cent. cows which are in most herds and are infected with tuberculosis of the udder.

Getting Rid of the Two Per Centers.

Vaccination of all cows which have mammitis and the elimination of such cows which will not respond to treatment with vaccine, i.e., such cows as will not respond to treatment with vaccine even in as large doses as 20 cc. per day (the treatment starting with 5 c.c. of vaccine as first dose) and at seven days' interval. If cows have tuberculosis of the udder there is no response. If she survives such treatment and still persists with active mastitis she is only fit for the local butcher if she is healthy in other parts of her body, but this is not likely. Therefore, the first loss is the best, and she should be shot and burned or buried deeply in some dry soil on the border of the cultivation paddocks. All cows suffering from mastitis should be isolated and the milk buried until such time as the vaccine treatment is carried out, and this could be done by the owner with the assistance, in an advisory capacity, of the Dairy Inspector of the district.

This is suggested as a very good and practical method of ridding herds of the more saturated cases of tubercular disease.

THE PAPAW.

By G. WILLIAMS, Instructor in Fruit Culture.

THE Papaw or Papaya (*Carica papaya*), originally reported as being indigenous to Central America and West Indies, is freely distributed throughout coastal Queensland. The small herbaceous tree is practically branchless and surmounted by a crown of large palmate leaves, at the base of which the fruit is produced, this usually maturing after the fall of the foliage from that part of the stem where it is situated. The branchless habit of the tree can be varied by the removal in the early stages of terminal buds, whereby branching is induced and several fruiting heads developed.

The Plant and Its Properties.

The succulent flesh is very agreeable to the taste, though preferred by many with the addition of sugar, lemon, or orange juice, the fruit being cut transversely, the seeds removed, and such additions as preferred applied in its capacious cavity. The fruit is credited with containing properties which materially aid digestion, as also are the seeds, which resemble watercress in flavour. The foliage applied as a wrapper is said to have the effect of rendering meat tender—a feature that exists mainly in imagination. From incisions made with a bone or ivory knife in the unripe fruit, the milky juice exudes freely and is collected, dried, and exported from the West Indies and Ceylon to other countries where it is sometimes used as a substitute for pepsin. The demand is said to be limited and irregular.

Under favourable conditions, the first fruit are matured within twelve months from planting; location and rainfall are responsible for variations. The term of productiveness is short, seldom exceeding four years, but this to some extent is compensated by its unbroken continuity.

Cultivation.

Fertile and well-drained soils are essential to successful cultivation. The most vigorous growth is evidenced and the finest fruit produced on volcanic scrub soils. The quality of the fruit varies under different conditions of soil, location, and humidity. Essentially a purely tropical product, the finest fruit are those matured without an excessive moisture. In some of the Northern scrubs Papaws are widely distributed, but under the influence of shade the trees are spindly and the fruit undersized and lacking in flavour. Fruit produced under semi-tropical conditions is admittedly inferior to the purely tropical product.

Varieties.

Various types or varieties have from time to time been introduced into Queensland, but the typical features have by cross fertilization been almost eliminated. Two types introduced to the North worthy of mention are the New Guinea or "Long Tom" and the Cowleyii or "New Era" said to have originated in the Philippines), both being bisexual. The elongated fruit of the former is not quite equal to the latter, but a heavier weight per tree is returned. Earlier introductions were confined to the ogininal unisexual variety, which from a batch of seedlings frequently developed an excess of male and consequently practically unproductive plants, though occasionally the panicles of male flowers are interspersed with those capable of fruit production; the fruit of such are invariably small and inferior. Various suggestions, more or less absurd, have from time to time been published as infallible tests for determining the sex of the young plant, but experience does not favour the acceptance of any of them. Among a batch of seedling plants a wide variation in vigour will be noted, and a reversion of the usual practice of selecting the strongest plants should be applied, for it is found that the most vigorous plants almost invariably turn out to be males.

Planting.

Seeds are planted in boxes or seed-beds under partial shade in early spring, and the young plants are put out when from 8 to 12 inches high, the foliage, except the young undeveloped crowns, being removed, allowing part of the petiole or leaf stalk to remain. Where plants are grown subject to the influences of shade, this should be removed several days prior to transplanting, also water should be withheld, but applied liberally just prior to removing, so that the roots may be mutilated as little as possible. In addition to fertility and good drainage, a soil containing a liberal proportion of humus favours development. No applications of fertilizers to light soils can maintain equal results. Liability or otherwise to frost should be considered

in respect to location, for there are few cultivated plants more susceptible to frost injury than the Papaw. In planting the possibility of numerous male plants is present. The effect to a great extent may be minimised by including in place of one plant two in close proximity, and subsequently removing one when the sex is determinable. If both are males they should be discarded, male trees being entirely superfluous. Six feet apart has been given as a reasonable distance for planting, but to this at least 2 feet can be added, with 9 or 10 feet between rows to allow for reasonable development and room for the necessary cultural operations.

Fertility being absolutely necessary, applications of fertilizers should be made in accordance with directions contained in the pamphlet "Complete Fertilizers for Farm and Orchard," issued by the Department of Agriculture and Stock, and obtainable on application to the Under Secretary, Brisbane.

Diseases and Pests Affecting the Plant.

Under fair conditions the Papaw is reasonably free from disease; fungus in Southern districts is sometimes evident on the fruit by discoloured areas of varying extent, causing decay in their vicinity and occasionally affecting the whole fruit. This is preventable by the application of Bordeaux mixture or Bordeaux powder. In some seasons the larva of a moth is persistent in its attacks upon the stem, which it usually enters close to the leaf bases, and may completely destroy the tree; against this it is questionable whether treatment is warranted. Red Spider amongst the young foliage and nematodes on roots are to a great extent attributable to placing plants in unsuitable soils, particularly those of a light sandy nature, though weather conditions adverse to growth are congenial to both pests. Dusting with fine sulphur will have some influence against the former, but remedial measures cannot be profitably applied against the latter.

Being a comparatively shallow rooter, weed growth should be eliminated from plantations and cultivation confined to a shallow depth, varying slightly according to the nature of the soil, 3 to 4 inches being quite sufficient in that of a close texture.

Marketing.

For marketing, sufficient care must be exercised so that the fruit is not bruised when handling, and packing is preferable in shallow trays or cases, so that there will not be undue pressure of fruit. Just at what stage of development the fruit should be gathered will vary according to distance from market and transport facilities, but the nearer the fruit approaches maturity at the time of taking from the tree the more pronounced will be its flavour, and when the market is readily accessible colouring should be evidenced at its apex.

In addition to its place as a dessert and entering into the composition of various condiments, the flesh of moderately mature fruit may by cutting into strips be satisfactorily dried by exposure. It is unlikely that the dried fruit will find a market where fresh supplies are available. The green fruit is utilised as a vegetable, treated and served in the same manner as a vegetable marrow.

QUEENSLAND SHOW DATES, 1932.

Killarney: 29th and 30th January.
Stanthorpe: 3rd to 5th February.
Warwick: 9th to 11th February.
Allora: 17th and 18th February.
Oakey: 19th March.
Goombungee: 2nd April.
Pittsworth: 6th and 7th April.
Chinchilla: 5th to 7th April.
Miles: 13th and 14th April.
Clifton: 13th and 14th April.
Toowoomba: 18th to 21st April.
Dalby: 27th and 28th April.
Charleville: 4th and 5th May.
Boonah: 4th and 5th May.
Mitchell: 11th and 12th May.
Roma: 16th and 17th May.
Ipswich: 17th to 20th May.
Gin Gin: 2nd to 4th June.
Marburg: 2nd and 3rd June.
Bundaberg: 9th to 11th June.
Rockhampton: 21st to 25th June.
Mackay: 28th to 30th June.
Rosewood: 15th and 16th July.
Royal National: 8th to 13th August.
Crow's Nest: 24th and 25th August.
Wynnum: 26th and 27th August.
Beenleigh: 16th and 17th September.
Rocklea: 24th September.
Nerang: 14th October.
Cleveland: 8th and 9th July.

INTENSIVE PASTURE MANAGEMENT—1.

By F. F. COLEMAN.

THE idea of "two blades of grass to grow upon a spot of ground where only one grew before" was mentioned by Swift in the early part of the eighteenth century; even rotational grazing is not a new idea as records exist of the movement of cattle from pasture to pasture, dating back to the latter part of the same century, and many dairymen in the southern part of England unconsciously used this method, by grazing rotationally small meadows adjacent to their homesteads. It is well known that some farmers as far back as the middle part of last century, in order to get an increased hay crop during their last year of tenancy, applied quick-acting nitrogenous fertilizers to grassland with the result that they produced a heavy crop of hay at the expense of the finer grasses, leaving the incoming tenant with a runout pasture. That nitrogen makes grass grow was a fact well known to agriculturists in Europe, but was overshadowed by the farmer's desire to increase the feeding value of his grassland, by top-dressing with phosphates to encourage the growth of clover.

In Queensland, with the exception of a few places, clover is practically absent and the copying of the phosphate methods adopted by the Southern States and European countries where clover is usually present, resulted in many opinions adverse to top-dressing of Queensland's coastal pastures. Some seven years since, a few small experiments were started to see the effect of various fertilizers. These experiments were afterwards extended to Runcorn, where clovers were entirely absent and the ground of a character not likely to give a quick response. The vicissitudes of the Runcorn experiments were written up by the Agricultural Chemist, Mr. J. C. Brunnich, and published in the Department's Annual Report of 1927. The experiments having been abandoned, records of after effects are not available. It is, however, known that when animals grazed on this area, the parts most closely grazed were those that had been top-dressed with a mixture giving a sufficiency of both nitrogen and phosphoric acid. Early in January, 1928, an experiment was started at Runcorn on land adjacent to the area previously abandoned, the objective being to try out animal preference or palatability and see the effect of suitable fertilizers on old *Paspalum dilatatum* pasture that had not been ploughed. The area in question was closely grazed during December, 1927, and then harrowed with ordinary iron harrows. It is now quite realised that better results would have been obtained had it been possible to use one of the stump jump renovators or some of the pasture harrows now on the market. Those used were the ordinary iron harrows not heavy enough for the purpose. During the first three weeks of January, just over six inches of rain fell. The fertilizers were applied on 24th January. The first area nearest to the gate accessible to animals did not have any fertilizer. The next portion had an application per acre of:—

Plot 1.—100 lb. ammonium sulphate, 159 lb. Nauru phosphate, 100 lb. superphosphate, 41 lb. potassium chloride.

The next area—

Plot 2.—100 lb. ammonium sulphate, 259 lb. Nauru phosphate, 41 lb. potassium chloride.

Adjacent to this was an area with—

Plot 3.—200 lb. superphosphate, 200 lb. Nauru phosphate.

and the last portion had—

Plot 4.—150 lb. ammonium sulphate, 237½ lb. Nauru phosphate, 150 lb. superphosphate, 61½ lb. potassium chloride per acre.

The different plots were in the same paddock and for purposes of reference can be called 0, 1, 2, 3, 4. The one without fertilizer being 0, which is before explained was nearest to the gate. The effect of the ammonium sulphate was well marked on the ninth day, when samples of the grass were cut from each lot. On or about the tenth or eleventh day some animals in an adjacent paddock broke through the fence and were with difficulty driven off the nitrogen plots. On the 20th and 44th days, grass samples were again cut for analysis, the results at the time were published, and afterwards appeared at the Brisbane 1928 Exhibition. At the time the green weight per acre was probably given too much prominence. The fact yet remains that without fertilizers in 44 days Plot 0 produced 3,062 lb. of green grass, Plot 1, 6,806, Plot 2, 4,840, Plot 3, 2,193, Plot 4, 17,658. It will, therefore, be seen, that any amount of twisting of the figures or explanations cannot evade the fact that the application of super and Nauru phosphate at the rate of 400 lb. per acre did not encourage the growth of grass. The portion that had ammonium sulphate at the rate of 100 lb. per acre and 100 lb. of super. per acre

with the addition of Nauru phosphate and potassium chloride produced more green grass than the portion with the same amount of ammonium sulphate and potassium chloride but without super. These plots were each about one acre in extent and the green weights ascertained from a series of cuttings. At the time, it was evident that those who advocated such dressing as 1 cwt. of super. and/or Nauru phosphate per acre, were attempting the impossible. Unfortunately, many dairymen consider all fertilizers to be super., and the quantity required 1 cwt. or less per acre, overlooking the fact that even in those areas where clover is in abundance applications of several cwt. per acre are often used.

The question of animal preference was tried out by putting about twenty head of stock into the old experiment area, and then letting them in through the gate that opened on the portion without fertilizers. Photos of the animals after they had been in the paddock just over half an hour were on several occasions taken. They invariably show the majority on Plot 4, that is the one top-dressed with 150 lb. ammonium sulphate and 150 lb. of superphosphate, the others more or less equally distributed between plots 1 and 2. On only one occasion did two animals stop on the super.-Nauru only, and the portion without fertilizer did not show any animals in the photos, nor were there any traces in that area of grazing, the greatest intensity of the grazing being on the plot with the largest amount of ammonium sulphate and superphosphate, followed by the paddock with lesser amounts of ammonium sulphate and superphosphate. The grass after March on the nitrogen portions had to be cut by a horse mower as at the time those interested in the experiment could not get sufficient stock to graze the area in the manner required.

Arising out of this experiment, endeavours were made to find a suitable site on someone's land where it would be possible to divide the area by fences and rotationally graze in order to give the stock the benefit of *young short grass* which has now been proven to be of high nutritive value and much appreciated by stock.

As a general principle it can now be accepted that rotational grazing fences should be erected in a manner calculated to give not less than 15 beasts to the acre; that is to say, anyone with a dairy herd of about 70 should have the area in each paddock not greater than 4½ acres. It is essential with all top-dressing that the land be first closely grazed, all rubbish and weeds cut down, and then treated with suitable harrows or a paspalum renovator of which there are several efficient makes on the market. Unless a thorough clear-up is made, it is impossible for the fertilizers to give their full effect. The results that will be published shortly of the experiments now being carried out by the Queensland Pasture Improvement Committee conclusively prove that the *carrying capacity of suitable land can be greatly increased* on areas of assured rainfall, *given efficient management* in the grazing and sufficiency of stock to utilise young grass when at its best, also by the careful preparation of the land and the sowing of suitable winter growing grasses, in particular such strains as are known to produce density of growth, leafiness, persistency, and at the same time to be of high nutritive value, combined with palatability. In this respect it must be pointed out that a good leafy strain of most of these grasses would not appear so high as the ordinary commercial types which readily produce seed heads. The strains, however, that produce an abundance of leafy herbage give more weight of feed per acre.

The fertilizers now recommended per acre on Queensland coastal dairy pastures are as follows:—

1 cwt. sulphate of ammonia (20.5 per cent. N.),
2 cwt. superphosphate (20.5 per cent. P_2O_5) water soluble phosphoric acid;
or—
1½ cwt. ammonium sulphate,
2 cwt. superphosphate;
or—
1½ cwt. ammonium sulphate,
2 cwt. superphosphate,
1 cwt. potassium chloride (50 per cent. K_2O).

In some cases where clover has hitherto failed to establish itself, double the amount of superphosphate should be used. It would also be advisable in such instances to apply at least 1 ton per acre of lime some time before the sulphate of ammonia is put on; although grass does best with ammonium sulphate and super., clover responds to superphosphate and potash. Most of the pastures would do better if limed; less than ½ cwt. of lime to the acre would be useless; even this quantity must not be mixed with sulphate of ammonia or applied just before its application. In all cases where cattle leave long grass and weeds, it is essential that they be cut down by a horse mower; and it will be found by any dairyman who makes a careful observation

that he is not getting the best out of his land by leaving long grass or other herbage not eaten by stock. The spreading of animal droppings by suitable harrows is also an essential of efficient management.

Grass and Clover Crops at Lawnton.

By the courtesy of the Queensland Acclimatisation Society, a series of grass, clover, and other forage plants are being grown at Lawnton. The plots include various strains of perennial and other rye grasses, *Phalaris tuberosa* (perennial canary grass), cocksfoot, &c., also Queensland's well-known Prairie, Rhodes and *Paspalum dilatatum* grasses. Although the first plots were only sown on 15th April, several cuttings have been made, which on analysis have again proved the high nutritive value of Prairie, closely followed by the special strains of perennial rye and other grasses. An article on the subject will shortly appear in the "Queensland Agricultural Journal"; in the meantime it is suggested that dairymen and others who are interested in winter-growing grasses might get into touch with this Branch so that arrangements can be made for them to inspect the plots, a careful examination of the growing plants being a more convincing argument than any amount of written matter.

Samples of these plants will be cut every few weeks, in order that analyses may be made showing their relative nutritive values at different stages of growth.

THE SILO.

IT is contended that the New Zealand farmer gets a better and more average yield from his cows than the Australian farmer in general, and the Queensland farmer in particular.

An investigation carried out some time ago, in order to determine the actual cause for this difference, led to conclusions which can be placed under several headings, the principle reasons being—

(1) Difference and greater variation in climate with consequent variation in feeding.

(2) Quality and breeding of the stock.

(3) Uniformity of feeding and housing.

It is quite evident that where nature has not provided a uniform food supply the ingenuity of man must provide something that will improve the conditions. In cold climates where it is impossible for an animal like the cow to live without shelter in the winter, man must take care to house it and feed it as a domestic animal.

The Australian farmer, as a rule, has no conception of the care and trouble which, for instance, the Danish farmer has to take with his animals, and has no conception to what extent the Danish farm cows repay for the care given to them. The Australian farmer is still very fortunate in this respect—that he has not to expend a large amount of money on providing winter shelter and fodder for his cows, and he considers it a hardship, sometimes, to even provide some form of dry fodder such as hay, because it entails extra work.

Many dairy farmers in Queensland are heard to express the opinion that it is easier for them to milk more cows, so long as they will live on the grass, than it is to have a better kind of cow which has to be fed and cared for. Whether this opinion is correct or not is a matter for the individual to judge, but for those who are anxious to improve the uniformity of their yield and so ensure a more constant and reliable income, there is no question but that the silo is one of the best means available.

Until recently the building of a silo was a fairly extensive undertaking which necessitated a fair amount of plant and equipment, and someone accustomed to and knowing a good deal about concrete and reinforcing was also desirable, and a number of experts, who advocated silos in order to secure the job, generally placed a fairly high value on their services.

A large silo is undoubtedly cheaper in proportion to the storage capacity than a small silo; but a large silo could easily prove an expensive proposition to run on account of the wastage. A reasonable average cost for a silo is, however, somewhere in the neighbourhood of £1 per ton capacity, providing that the capacity of the silo is not less than about 70 or 80 tons.

The diameter of a silo has, of course, to be governed by the quantity of ensilage used per day, and a small silo would, in that case, in spite of the higher first cost, be a more payable proposition to use than the larger one.

A recent invention which is advertised in the Journal will place a silo within the means of every dairy farmer who cares to improve his feeding arrangements, and who would like to ensure a uniform cheque every month. The erection of the silo now advertised is a very simple matter indeed, and there is hardly any need to stress the advantages of a silo.

The effect of uniform feeding on the breeding of stock is well known to all careful breeders. It is only by strict attention to such points as have been mentioned that the best points can be brought out in any breed, and the silo is a means of overcoming intermittent pasture difficulties and other feeding problems. After all, what one can do another can, and seeing that the New Zealand farmer, and very largely the Victorian farmer, has overcome most of his difficulties just by such means, there is no reason why Queensland should not be at the head of the list rather than, as at present, at the bottom.

EXPORT TRADE IN FAT LAMBS.

A memorandum from the Chief Veterinary Officer, Commonwealth Department of Markets, has been received by the Department of Agriculture and Stock, embodying a list of suggestions prepared by Mr. R. H. Heywood, veterinary officer, London, in connection with the export trade in Australian fat lambs. These suggestions are as follows:—

"1. The past season has shown some evidence that the prejudice which has characterised the trade in Australian lambs is weakening, and this can only be due to the improvements which have manifested themselves in the quality of the lambs themselves, to the good dressing, and the excellent condition in which they have been marketed. The natural bloom on carcases has been a striking feature, far in advance, it is said, of New Zealand and South American shipments. These facts alone suggest the need for the greatest attention to details, however unimportant they may appear to shippers.

"2. With improvement in the lambs' points which were relatively unimportant have assumed significance, and there is one in particular to which I have been requested to refer.

"3. The tension placed on the shoulder muscles by stringing (the necks) too tightly has a bad effect on both the appearance of the forequarter and on the joint itself when the carcass comes to be cut up by the retailer. Tight stringing draws the shoulder muscles taut, and if cut when frozen they recede from the shoulder blade when defrosted. It is thought that by allowing up to an inch on either side this can be corrected. The foreleg should hang not naturally, perhaps, but in a straight line with the hind leg. This is not easy to explain, but is easy to demonstrate by means of a straight edge.

"4. It is most important that no carcases which do not conform to the characteristic standard of the Down Cross lamb should be marked as Down Cross, but it is equally important that characteristic Down Cross lambs should be so marked.

"5. It is desirable that Down Cross tags should be attached by means of a coloured string, and also the wraps should be marked distinctively in the same colour.

"6. It is important that tagging should be done uniformly (always on the same leg) and neatly. Even the string itself is worthy of attention, and apart from the point of quality there are quite a number of ways in which the attractiveness of consignments can be improved.

"7. Generally speaking, the clearer and more simple that markings are made the better, and shippers will be wise to adopt the suggestions of their agents regarding distinctive markings. The latter are unlikely to suggest anything which will not facilitate sorting, for this sometimes is a laborious and costly process.

"8. Regarding consignments, where tags should bear the shippers' individual mark, a simple method has been adopted in New Zealand which appears to give complete satisfaction to the trade. Each shipper is given a number 1, 2, 3, and so on, and if his consignment includes 2's, 3's, and 4's (weight grades) his tag marks will be simply in the case of No. 1 12, 18, 14, and in the case of No. 9 92, 98, 94, and so on. The last figure is accepted in store as the grade mark. As a double precaution, the same number as is borne by the tag is stencilled in bold figures on the wrap.

"9. When arranging parcels for export the Downs should be separated from the remainder, and this should be stated on the bill of lading, as this is the only guidance the port of London authority has in arranging storage.

"10. Shippers of small lots would be wise to adopt pooling with a view to reducing storage expenses, though incidentally buyers will more readily take up parcels of reasonably large quantities. Parcels of under one hundred are subject to an additional charge of one third, and there is a minimum charge of 3s. (for even one carcass).

"11. It has been noticed that when the atmosphere is at all moist the dye from red labels which are used runs freely, and in some cases is most unsightly. Waterproof colours should be used, or the coloured labels replaced by some other distinctive marking."

TRAVELLING STOCK BY LAND, RAIL, AND SEA.

By W. C. CARMODY, Stock Inspector.*

THIS talk is not intended for those who are conversant with the law relating to travelling stock, but for those who do not know the requirements of "*The Diseases in Stock Act of* 1915" and amendment Act of 1930.

Points to be Observed.

Stress is laid on the necessity of strictly observing the following points:

(1) Lodge your notice of intention to travel stock with the inspector of stock.

(2) Obtain the permit to travel.

(3) Fill in the waybill supplied, with the number, brands, and description of the stock, accurately describing the brands. If a beast is unbranded, that is a fact which must be stated.

(4) Do not fail to give notice when entering on to a run, not more than forty-eight hours nor less than twenty-four, to the occupier by letter, telephone, or telegraph.

(5) Include plant horses on the waybill, or a separate waybill if horses are owned by drover.

(6) Travel the distances required—6 miles for sheep, 8 miles for cattle a day. Close gates after passing through.

(7) Report promptly any outbreak of disease to nearest stock inspector.

(8) Do not leave any diseased or dead stock on any run or stock route.

(9) Do not depart from the route set out in permit and waybill without the authority of an inspector.

The Permit to Travel.

If wishing to travel stock the first step is to fill in the notice of intention to travel stock (7th Schedule), which sets out the number, description, holding where located, name of owner, the route to be travelled, name of person in charge, date of proposed departure, and destination. Having lodged the notice of intention to travel stock with the inspector for the district or place, a permit (8th Schedule) will be issued by an inspector for the number of stock to be travelled, setting out in slightly altered form the particulars contained in the notice of intention. Having received the permit to travel, it will be noticed that a time limit is stated thereon in which the journey must be commenced.

The Waybill.

With the permit a waybill is issued (9th Schedule) which is printed on the back of the permit. This is a very important form, and great care should be taken to complete it correctly, setting out the name and address of owner, place or run, number of stock, brands, description, destination, consignee, how travelled (rail or road or both), and route to be taken. The brands, for purposes of identification, are most important, and therefore the stock travelled should be described fully and accurately.

* In an address by radio from Station 4QG.

Where station cattle bearing only one brand are being travelled, it is an easy matter to complete the description, but where the cattle are a mixed lot, and bearing different brands, more care must be taken. The brands should be grouped, e.g., five of one brand, ten of another, and so on.

If the cattle should be cross branded—that is to say, all the cattle bear the one brand (put on by purchaser) in addition to the different brands already mentioned, the grouping should apply, plus the cross brand, on all of the cattle. If travelling by road the plant horses used should be described on the waybill; frequently the horses will belong to the drover. Therefore it is the drover's duty to provide a waybill for his own horses.

If the waybill is accidentally lost or destroyed, the drover should apply to the nearest inspector of stock or police officer for an interim waybill. The inspector, on satisfactory proof of such loss, grants an interim waybill on payment of £1.

Daily Travelling Distance.

Cattle must travel on an average 8 miles a day and sheep 6 miles. It is obvious that when stock are travelled by rail or sea, the distances mentioned will not apply.

It is not necessary to brand sheep travelling by rail with the letter 'T' (T denotes travelling sheep), or which are not intended to be driven more than 40 miles to a destination, or which may have strayed on to a neighbour's holding, or which are intended to be driven to a pound. Any justice of the peace, police officer, or inspector duly authorised may inspect travelling stock. The drover should, on request, submit the stock in his charge to such inspection, and produce his waybill. Any drover who fails to comply, or travels stock by any other route than that described in the waybill, unless with the approval of an inspector, or fails or refuses to produce the waybill on the request of any inspector, justice of the peace, police officer, or occupier of any holding, through or alongside which any such stock are, or have been, travelling; refuses to permit those authorised when necessary to examine and count such stock, or fails to assist at any inspection, examination, or count of such stock when required; has in his possession or charge stock not fully and accurately described in the waybill, is liable to a penalty not exceeding £50.

Any person who purchases or receives from any owner or drover any stock not fully and accurately described in the waybill, or any stock from any drover who does not produce written authority from the actual owner of such stock to sell or otherwise dispose of them, is liable to a penalty not exceeding £50.

Reporting Stock Passings.

The owner or drover in charge of travelling stock who intends to drive them on or across any holding, or along any road which intersects or forms a boundary of any holding (unless the road is fenced on both sides), should give the occupier of the holding not more than forty-eight hours nor less than twenty-four hours' notice by letter, telephone, or telegraph, to the head station or principal homestead. Failure to give the prescribed notice renders the owner or person in charge liable to a penalty not exceeding £50. The notice prescribed shall not apply to an owner of cattle or horses in use at the time for the purposes of his calling.

Outbreak of Disease.

Should disease make its appearance in travelling stock, the owner or drover should, before the expiration of one week from the time of his discovering the fact, give notice thereof to the nearest inspector. The owner or drover should as far as possible draft out and keep separate all diseased stock from the healthy animals.

It is an offence to leave any infected stock or any carcass on a road or stock route. The penalty for this is a fine up to £10.

Play the Game on the Road.

It is an offence not to close gates erected on a road or stock route, or to give false information to an inspector on obtaining a permit for the removal of stock, or regarding the ownership of stock.

Motor Transport.

Stock are sometimes travelled by motor lorry. Such transport comes under the Act the same as travelling by rail.

CLIMATOLOGICAL TABLE—OCTOBER, 1931.

Compiled from Telegraphic Reports.

Districts and Stations.	Atmospheric Pressure. Mean at 9 a.m.	Shade Temperature. Means. Max.	Means. Min.	Extremes. Max.	Date.	Min.	Date.	Rainfall. Total.	Wet Days.
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cooktown	30·03	85	73	86	15, 18, 21, 22, 24, 26, 30, 31	65	12	15	2
Herberton	..	79	57	90	10	4[illegible]	[illegible]8	57	3
Rockhampton	30·09	84	63	93	28,30,31	51	5, 6	70	3
Brisbane	30·12	78	58	90	10	43	12	58	6
Darling Downs.									
Dalby	30·09	80	52	93	30	5[illegible]	5, 6, 12	239	3
Stanthorpe	..	71	41	86	30	39	10	216	5
Toowoomba	..	74	49	88	30	39	5, 12	151	3
Mid-Interior.									
Georgetown	29·99	92	66	99	31	59	6	136	3
Longreach	30·03	88	58	102	29	44	5	380	4
Mitchell	30·08	82	50	95	29	37	5	117	5
Western.									
Burketown	29·99	91	67	97	19	55	5	0	..
Boulia	30·03	89	60	104	2, 29	48	4, 5	22	1
Thargomindah	30·07	83	55	100	29	40	5	30	2

RAINFALL IN THE AGRICULTURAL DISTRICTS.

Table showing the Average Rainfall for the Month of October, in the Agricultural Districts, together with Total Rainfall during October, 1931, and 1930, for Comparison.

Divisions and Stations.	Average Rainfall. Oct.,	No. of Years' Records.	Total Rainfall. Oct., 1931.	Oct., 1930.
North Coast. ..	In.		In.	In.
Atherton	0·90	30	1·11	3·02
Cairns	2·09	49	5·23	17·58
Cardwell	2·05	59	3·40	11·34
Cooktown	1·08	55	0·15	5·80
Herberton	0·91	44	0·57	3·09
Ingham	1·92	39	3·35	19·15
Innisfail	2·99	50	4·57	13·47
Mossman Mill ..	3·10	18	4·46	12·13
Townsville	1·37	60	3·68	10·79
Central Coast.				
Ayr	1·00	44	1·09	3,94
Bowen	1·05	60	0·82	2·00
Charters Towers ..	0·69	49	1·01	2·10
Mackay	1·70	60	1·18	0·66
Proserpine	1·77	28	0·90	1·94
St. Lawrence ..	1·75	60	0·24	1·09
South Coast.				
Biggenden ..	2·18	32	2·53	0·82
Bundaberg	1·99	48	1·47	1·97
Brisbane	2·53	80	0·58	1·97
Caboolture	2·51	44	0·89	3·92
Childers	2·48	36	2·26	1·90
Crohamhurst ..	3·29	38	1·61	1·86
Esk	2·53	44	1·17	4·12
Gayndah	2·33	60	2·38	0·84
Gympie	2·69	61	1·48	2·31

Divisions and Stations.	Average Rainfall. Oct.,	No. of Years' Records.	Total Rainfall. Oct., 1931.	Oct., 1930.
South Coast—continued:	In.		In.	In.
Kilkivan	2·61	52	0·65	1·12
Maryborough ..	2·63	59	1·28	0·79
Nambour ..	2·97	35	0·99	1·94
Nanango	2·28	49	0·87	1·69
Rockhampton ..	1·78	44	0·50	1·08
Woodford	2·46	44	0·86	1·77
Darling Downs.				
Dalby	2·00	61	2·39	1·05
Emu Vale	2·17	35	1·00	2·28
Jimbour	1·87	43	1·91	1·22
Miles	1·96	46	1·84	1·89
Stanthorpe ..	2·55	58	2·16	2·31
Toowoomba ..	2·57	59	1·31	2·92
Warwick	2·29	66	1·33	2·57
Maranoa.				
Roma	1·75	57	0·72	2·61
State Farms, &c.				
Bungeworgorai ..	1·42	17	0·82	2·50
Gatton College ..	2·02	36	1·00	1·41
Gindie	1·36	32	0 33	0·15
Hermitage ..	1·90	25	0·97	1·84
Kairi	1·07	17	..	3·70
Mackay Sugar Experiment Station	1·44	34	0·94	0·62

J. H. HARTSHORN, Acting Divisional Meteorologist.

Answers to Correspondents.

Tanning Marsupial and Other Skins.

The following information is supplied in answer to several correspondents:—

(1) *The Lightning Process.*—Cut off all useless parts of the skin, and then soften the skin by soaking so that all flesh and fat may be scraped from the flesh side with a blunt knife. Next soak the skin in warm water for an hour, and during that time prepare equal quantities of borax, saltpetre, and glaubers salt, with enough water to make into a thin paste. About half an ounce of each ingredient will give enough for an opposum skin, and proportionately more will be required for larger skins. When the skin has been soaked in the warm water, lift it and spread it out flat, so that the paste may be applied with a brush to the inside of the skin. More paste will be required where the skin is thick than where it is thin. Double the skin together flesh side inwards, and place it in a cool place for twenty-four hours, at the end of which time it should be washed clean and treated in the same way as before with a mixture of 1 oz. of sodium carbonate (washing soda), 1 oz. borax, and 2 oz. hard white soap; these must be melted slowly together without being allowed to boil. The skin should then be folded together again and put in a warm place for twenty-four hours. After this, dissolve 4 oz. alum, 8 oz. salt, and 2 oz. of sodium bicarbonate (baking soda) in sufficient hot water to saturate the skin. The water used should be soft, preferably rain water. When this is cool enough not to scald the hands, the skin should be immersed and left for twelve hours. Then wring it out and hang it up to dry. The soaking and drying must be repeated two or three times, till the skin is soft and pliable, after which it may be rubbed with fine sandpaper and pumice stone to obtain a smooth finish.

(2) A second method, in which wattle bark is the tanning agent, is not so quickly accomplished, but properly adopted it should give better results than the other. Collect some sound wattle bark and make a strong decoction by boiling or steeping the bark in water. A bushel of crushed bark from a tannery, if one is near at hand, will be found an easy way of getting the best bark. The skin should be scraped clean on the inside, as in the lightning process, before steeping begins. It is best to let the skins lie as flat as possible while soaking, and a large, square, zinc-lined packing case is therefore preferable to a barrel. The skins should be thoroughly covered with the liquid, which must either be changed once a week or boiled anew and skimmed. While the skin is out of the liquid each week it should be lightly scraped. Large skins take up to six weeks to tan well, but opossum skins will not require more than a month.

(3) Another method spoken highly of by those who have tried it, especially where a clean white skin is required, is well worth trial.

Pour 2 quarts of boiling water over 1 quart of bran, and in 2 quarts of warm water at blood heat dissolve as much salt as it will take up—between 4 and 5 oz. Then mix the salt water and bran water together, making 1 gallon to which add 1 oz. of sulphuric acid. Soak the skins in this mixture using an earthenware vessel and stirring well for twenty minutes, then rinse in clean cold water and hang to dry in a shady place. As they dry, pull the skins well and scrape off any pieces of fat that may be found. The skins, when dry, should be white.

The following recipes are also well worth a trial:—

4. Tack the skin tightly on a board; scrape off all the loose fat and work in chalk, rubbing it in well. When the chalk begins to powder and fall off, remove the skin from the board and rub in plenty of powdered alum. Wrap up closely and keep in a dry place for a few days. This makes the hide pliable; it will retain its hair.

5. Mix two parts of saltpetre and one of alum. Sprinkle on the flesh side of the skin, roll it up and keep it in a cool place. After a few days spread out to dry. Scrape off the fat and rub it until the hide is pliable.

6. *Method for Tanning Woolly Skins.*—Preparing sheepskins for mats, woolly waistcoats, &c., is simple and quite satisfactory where a particularly supple leather is not required. First trim all ragged edges and remove as much flesh, fat, &c., as possible without cutting the pelt. Then place the skin on the floor or on some table, flesh side uppermost, and proceed to wash the flesh well with warm water and soap, and then with clean water. Remove all surplus water from the wool by pressing or squeezing with a towel, board. Take up the skin and shake it well and then place it loose ends on a clean surface, and take a good handful of alum, to which a little salt may be added, and proceed to rub it well into the pelt with a rolling motion over all the surface equally. Then fold the skin, fleece outward, and

let it stand for three days. After this, open and hang the skin for a while and then start to scrape it with a furriers knife—a knife without an edge—always scraping in the same direction. Three scrapings are needed to properly finish the pelt. With different skins, discretion must be used in the matter of scraping. Strong pelts will naturally require and stand a more thorough scraping.

(7) *White Hide: Tanning Process on the Farm.* As it is almost impossible to enumerate the uses to which good white hide may be put, especially on a farm, the necessity for careful selection of the hide to be treated cannot be too greatly stressed.

The ideal hide for general purposes, such as harness repairs, leg ropes, cart and sulky reins, bridles, bullock whips and falls, straps of all sizes, &c., is that of a fat, four-year old, whole-colour Shorthorn steer or heifer, the latter being slightly finer.

If a thinner and much finer quality hide is required, a four to six-year old, whole-colour Jersey female in good condition will produce it. Hides to be carefully avoided for farm tanning are those of spotted or poor animals, of whatever age. In the former case it has been conclusively proved that wherever there is a white patch the hide is thinner, and good work cannot be done with a hide of varying thickness; in the case of poor animals the hide is practically useless.

Before killing have ready a well-scoured cask (a 40-gallon one will hold any hide), put in about 16 gallons of water, and a good half bucket of slaked lime. This is to loosen the hair and neutralise the fat. Bleed the animal first from the heart, then sever both artery and jugular vein in the neck. Have the head slightly down hill if possible. Skin carefully as a bad score or cut may spoil an otherwise good strip. While warm, skin off as much waste as possible. Trim off scraggy leg and belly points, and allow the hide to become cold.

Stir the lime and water, and lower the hide slowly into the liquid to prevent the formation of air pockets, poke down, and stir again. Weight down with wood any portion that comes to the surface. Do this once a day or more frequently until the hair begins to come off. Throw the hide over a barrel or on a flat surface and scrape both sides clean with a skinning or fleshing knife. Be careful not to mark the hair side with the knife. If all the hair does not come off at first, put back for a day or two. Empty and sluice the cask; about half fill it with clean water, and leave the hide in it while preparing the curing solution.

Dissolve 8 lb. of salt, common or coarse, in half a kerosene tin of boiling water; leave to cool. Dissolve 4 lb. of powdered alum in half a kerosene tin of boiling water; leave to cool. Mix 8 lb. of white flour into a thin paste, free of lumps. The best way to do this is to put about 2 lb. of flour into a kerosene tin and mix into a stiff paste with cold water, add a little more water; stir briskly with either the hands or a stick. Repeat this until the tin is about half full. The hide can now be thrown over a fence or the like to drain. Empty the cask and put the flour paste in. Mix more flour as before up to 8 lb. and add to that in the cask. When the alum and salt solutions are cool, add the flour paste and mix thoroughly. Allow to stand over about fifteen minutes and mix again. Lower the hide as before and add just sufficient clean cold water to cover. Poke down with a heavy stick until you are sure that all air is out, and weight with wood any portion that comes to the surface. Leave for two days. Stir at least once a day for three weeks. Take care each time to stir right from the bottom; get all the air out, and weight it down as before. Do not allow iron to come into contact with the hide when in the solution as it will leave an indellible rust patch.

When the time is up, hang the hide in the shade, throw a few buckets of water over each side, and leave for about half a day, reversing it occasionally. Spread on a flat surface, and rub in with a smooth-ended piece of wood, equal parts of common tallow and neatsfoot oil on one side only, using plenty. Leave for a few hours if convenient, then roll up as tightly as possible. Wrap up in bags and leave for a few days, when it will be ready for use.

THE JOURNAL APPRECIATED.

A Clifton reader writes:—"We appreciate the excellent articles in the 'Queensland Agricultural Journal' very much. It always contains something worth reading and expressed in a fresh style."

General Notes.

How to Mix Paint.

The different coats of paint vary in their composition. The first coat laid on new work requires a good deal of oil to soak into the material; on old work the first coat requires turpentine to make it adhere. The second coat contains a proportion of turpentine to make it work smoothly, and to the final coat is added the colouring material.

The first coat of paint applied to newly-worked wood is termed the priming, and before it is applied all holes should be neatly filled up with putty made of whiting and boiled oil. Nothing is gained by laying the paint on thickly; a thick film naturally takes longer to dry than two thin coats. Paint is thinned with linseed oil or turpentine. An excess of turpentine gives the paint a dull appearance.

When the surface to be painted is already covered with old paint, this should be either removed by means of a spirit lamp or rubbed down with a pumice stone or a smooth bit of marble. The exact proportion of ingredients to be used in mixing paint depends upon various conditions; but for inside work, and to cover 100 square yards of newly-worked pine, the following are the approximate quantities:—

Primary red lead, ½ lb.; white lead, 16 lb.; raw oil, 6 pints; drier, ¼ lb. Second coat: White lead, 15 lb.; raw oil, 3½ pints; turpentine, ½ pint; drier, ¼ lb. The third and fourth coats consist of 13 lb. white lead and raw oil, turpentine and drier as before. The quantity of colouring matter to be added to the white lead base depends upon the shade desired.

Stone colour is produced by adding burnt or raw umber and yellow ochre. For French grey add Prussian blue and a little lake, used in different proportions. These will make purples and lilacs of all shades. Spanish brown or Venetian red or black, thinned with boiled oil and a little turps, will produce chocolate-coloured paint.

Staff Changes and Appointments.

Mr. Thomas Kerwin, of Mountain View, Coochin, via Boonah, has been appointed an Honorary Ranger under and for the purposes of "*The Animals and Birds Acts, 1921 to 1924*," and "*The Native Plants Protection Act of 1930.*"

Mr. C. G. Revitt, of Dunk Island, has been appointed as Honorary Ranger under the Animals and Birds Acts.

Constable C. R. Cooke, who is in charge of the Bell district, has been appointed also an Inspector under the Slaughtering Act.

Mr. H. J. Freeman, Senior Instructor in Fruit Culture at Cairns, has been appointed also an Inspector under the Diseases in Stock and the Brands Acts.

Mr. C. S. Clydesdale, Senior Instructor in Agriculture in the Department of Agriculture and Stock, has been transferred to Rockhampton, where he will fill the position recently rendered vacant by the appointment of Mr. G. B. Brooks as Director of Agriculture.

Provisional Maize Board.

In pursuance of the provisions of "*The Primary Producers' Organisation and Marketing Acts, 1926 to 1928*," the following have been appointed members of the Provisional Maize Board until the 14th October, 1932:—

Messrs. W. A. Fielding (Moreton District); J. Archibald (Darling Downs District); W. L. Osborne (Burnett District); E. Graham (Director of Marketing); J. McRobert (Chairman, Executive Committee of the Council of Agriculture); and Wm. Bailey (Atherton Tableland Maize Board).

Arrowroot Board.

The Governor in Council has approved of the issue of an Order in Council under the Primary Producers' Organisation and Marketing Acts, adding two subsections to Section 15 (1) of the abovementioned Acts, which apply to arrowroot.

These subsections provide that an arrowroot grower or miller shall not, without the prior written consent of the Board, remove any of his commodity except for the purpose of delivery to the Arrowroot Board or its agent, as required by Section 15 (1) of the Acts. Also, a penalty is imposed for any contravention or evasion of the above.

A Monto Sanctuary.

A portion of "Rockybar," Hawkwood, in the Monto district, the property of Mr. R. A. Hamilton, has been declared a sanctuary under the Animals and Birds Acts, in which it will be unlawful for any person to take or kill any animal or bird.

Trees and Citizenship.

It is now clearly seen that the man who plants trees is rendering an even greater service to his country than the man who grows food (writes Richard St. Barbe Baker in Melbourne "Argus"). Tree-planting is becoming the touchstone of true citizenship. In planting a tree man is for ever safeguarding the future. The science of forestry arose from the recognition of a universal need. It embodied the spirit of service to mankind in attempting to provide means of supplying every necessity of life, and, in addition, of ministering to man's aesthetic taste and recreational interests. In Australia there is untold wealth in the forests. Trees which formerly have been regarded as comparatively useless are finding fresh markets, and most varieties of eucalypt in due time will be highly used in industry. These forests are a priceless heritage, which must be handed down to posterity. There is no place in the world that can grow the eucalypt in such profusion as can Australia. There is a variety for each day in the year, and each and all will contribute their share to the prosperity of the country.

Broom Millet Board.

The Governor in Council has approved of the issue of an Order in Council under "*The Primary Producers' Organisation and Marketing Acts, 1926 to 1930*," extending the operations of the Broom Millet Board for a further period of three years from the 1st November, 1931, to the 31st October, 1934.

The term of the present Broom Millet Board will expire on the 31st October, and an Order in Council giving notice of intention to extend the Board for another three years was approved on the 10th September last. A petition for a poll to decide whether or not the Board should be extended was invited, and as no petition was received, and in accordance with the provisions of the Acts, the Order in Council to extend the Board for a further three years has been approved.

Cattle Poisoning Sawfly.

The cattle poisoning sawfly has been the cause of considerable losses to cattle-growers in the Maranoa district this year. The Minister for Agriculture and Stock (Mr. H. F. Walker) stated recently that as soon as advice was received by his Department indicating the presence of sawfly larvæ on the ground within reach of cattle, an officer of the Entomological Branch was despatched to the infested area. That officer made a series of field observations and a considerable quantity of material was brought to Brisbane for examination in the departmental laboratories. The Agricultural Chemist of the Department is conducting a series of analyses which it is hoped will shed very considerable light on the problem. Mr. Walker said he hoped to be in a position to authorise the publication of a progress report at an early date, and that such report would indicate the most suitable lines along which control might be exercised.

Mr. Walker said that according to newspaper reports the opinion had been expressed that the sawfly problem was a more serious one than the buffalo fly was ever likely to be in those districts in which the sawfly was responsible for losses. The relative importance of the two pests in the Maranoa district, should the buffalo fly ever become established therein, was, of course, a matter on which there might very legitimately be a difference of opinion at the present juncture. With respect to the relative importance of the two pests to the State as a whole the Minister, however, held very definite opinions. As a result of a recent personal investigation in the Gulf country, he was convinced that the buffalo fly was a much graver menace to Queensland cattle-growers than the sawfly was ever likely to be. It must be remembered that the buffalo fly, which is an introduced pest, had so far infested only a very small proportion of the country which was suitable for its propagation in the State of Queensland. The sawfly, on the other hand, was a native insect which has already occupied the territory suitable to its propagation, and its association with losses in cattle was not likely to extend. While holding these views as to the relative importance of the two pests, Mr. Walker was nevertheless very appreciative of the unfortunate position of those cattle-growers who had suffered serious losses. As indicated, however, the Department had promptly taken up the investigation of the practical aspects of control as soon as this year's outbreak had occurred.

An Oxley Creek Sanctuary.

The Governor in Council has approved of the issue of an Order in Council declaring a certain area surrounding Oxley Creek to be a sanctuary under the Animals and Birds Acts. It will be unlawful for any person to take or kill any animal or bird within this area, which may roughly be described as contained within the boundaries from Softstone street, Tennyson, by the Yeerongpilly Golf Links, Sherwood road, Ipswich road to Oxley Hotel, then by Oxley road to the Brisbane River at Albert Bridge, and by the right bank of the river to Softstone street.

Buffalo Fly.

As an instance of the activity of the buffalo fly in the Gulf area at a period of the year when the pest is popularly supposed to be quiescent, the Minister for Agriculture and Stock (Mr. H. F. Walker) referred to an extract from a letter recently received from the Superintendent at Mornington Island, in the Gulf of Carpentaria, in which he advised that the buffalo fly was still active amongst the cattle on the Aboriginal Settlement. He stated that reports from musterers indicated that many of the cattle have nasty open sores on their shoulders and around their eyes as a result of the fly, and he expressed a hope that a remedy would soon be found, otherwise he forsaw the possibility of the passing of the small herd at the Settlement, which had been gathered together at no mean expenditure of time and trouble.

Provisional Maize Non-Marketing Board.

Executive approval has been given to an Order in Council under "*The Primary Producers' Organisation and Marketing Acts*, 1926 *to* 1930," constituting a Provisional Maize Non-Marketing Board.

The Order provides that the provisions of the abovementioned Acts shall apply to the maize industry, and all maize grown in Queensland, except that grown on the Atherton Tableland, shall be a commodity under the Acts.

There shall be constituted a Board for the industry, excluding the Atherton Tableland. Until the Board is empowered by Order in Council, subject to an affirmative vote of the growers, to undertake marketing functions, the Board shall not be a marketing Board.

The Board shall operate for twelve months, and shall consist of one representative of growers from each of the Moreton, Darling Downs, and Burnett districts; the Director of Marketing; the Chairman of the Executive Committee of the Council of Agriculture, and, when necessary, one representative of the Atherton Tableland Maize Board.

The Council of Agriculture shall nominate the growers' representatives on the Board, and the Minister shall appoint the members to hold office for the term of the Board.

The functions of the Board shall consist of—

(*a*) Investigations regarding the manufacture of maize by-products and the extraction of power alcohol.

(*b*) Procuring or preparing reports regarding the marketing of the product.

(*c*) Arranging with produce merchants and agents with a view of improving existing marketing conditions.

(*d*) Arranging for the submission of marketing proposals to growers at a time considered opportune, and conducting such organising arrangements as may be considered desirable to ensure the acceptance of same by growers.

(*e*) Imposing a levy, with the approval of the Minister, on growers (except maize grown on the Atherton Tableland) to cover administrative and other expenses incurred by the Board, such levy to be for such term and at such rate (not exceeding one penny on every £2 value of maize marketed) as the Minister shall determine.

(*f*) Taking action to improve the conditions of growers pending the application of control to the marketing of the commodity.

(*g*) Issuing, through the Minister, periodical reports.

The Board may call for returns from growers showing the quantity of the commodity held at any time and any other particulars as may be specified.

Cotton Board.

The following nominations have been received in connection with the election of six growers' representatives to the Cotton Board:—

District No. 1—
John Beck (Stanwell);
Francis Albert John Bone (Bouldercombe, via Rockhampton);
Joseph Henry Cummings (Mount Larcom).

District No. 2—
Harry Reeves Brake (Wowan);
Charles George Young (Wowan).

District No. 3—
Arthur Edwin Balchin (Mount Scoria, Thangool);
George Herbert Bradley (Argoon);
James Patrick Fleming (Biloela);
Noel Richard Mullally (Goovigen).

District No. 4—
James Bryant (Chowey) returned unopposed.

District No. 5—
Charles Litzow (Vernor);
David Charles Pryce (Toogoolawah).

District No. 6—
Daniel Jones (Brisbane);
Ferdinand August Kajewski (Ma Ma Creek, via Grantham).

The election will be by postal ballot, and the date fixed for the return of the voting papers is the 9th December.

Control of Brumbies.

The Governor in Council has approved of the issue of a Proclamation under "*The Diseases in Stock Acts*, 1915 *to* 1930," declaring the Toowoomba and Rockhampton Stock Districts as districts for the control of "brumbies" from the 1st November, 1931, to the 29th February, 1932.

The Governor in Council has approved of the issue of a Proclamation under "*The Diseases in Stock Acts*, 1915 *to* 1930," declaring the Cairns and Cooktown Stock Districts as districts for the control of "brumbies" from the 17th October, 1931, to 12th January, 1932.

The Governor in Council has approved of the issue of a Proclamation under the Diseases in Stock Acts, proclaiming the Stock Districts of Clermont and Springsure as Districts for the control of "brumbies" or worthless horses, for the period from the 1st December, 1931, to the 31st March, 1932.

The abovementioned Acts provide, among other things, for the destruction of brumbies on stock holdings in Queensland under certain conditions. The provisions, however, only apply to such portions of the State as are proclaimed by the Governor in Council, and are limited to a period of not more than four months in any year. Destruction of brumbies, therefore, may be carried out in the above districts by stock owners at any time during the period stipulated, provided that all formalities required by the Acts have first been observed.

World-wide Demand for British Breeds of Pigs.

The National Pig Breeders' Association of England reports that during 1930 over 300 pedigree pigs were exported from the British Isles to overseas customers. During the last three months of the year forty export certificates were issued in respect of pedigree Large Whites, Middle Whites, Tamworths, Berkshires, and Wessex Saddleback pigs. Many of the orders were "repeats," which affords further proof of the value of British pigs for improving the standard of the breeds in other countries. Their 1930 volume of trade was a not inconsiderable contribution to Britain's agricultural export trade, and one which indirectly benefits many others than the actual vendors of the exported stock. Among other countries stock were sent to Latvia, Hungary, Portugal, France, Poland, Kenya, India, Japan, Germany, and Australia.

Obituary—Mr. Harold Lloyd Pentecost.

The death occurred on Sunday, 27th September, of Harold Lloyd Pentecost, an officer of the Herd Testing Division of the Department.

Mr. Pentecost, who was 54 years of age, was a native of Mornington, Victoria. He came to Queensland at an early age and engaged in the cheese industry at Beenleigh and other centres. He then settled in the Warwick district, where he was responsible for the successful establishment of cheese factories at Greymare, Rodger's Creek, Pratten, and Omanama. In April, 1922, he was elected as a producer's representative on the Cheese Board, and in January, 1923, was appointed as a Herd Testing Officer, in which capacity he was well and favourably known to large numbers of dairy farmers throughout the State. Mr. Pentecost took an active interest in social life, being a life member of the Warwick Hospital and the Nundah Show Society. He was actively interested in bowls, being largely instrumental in forming the Nundah Bowling Club, of which he was the first president.

He is survived by his widow, his daughter Evelyn, and two sons, Lloyd and Allan.

Fruit Marketing—Don't Always Blame the Agent.

Don't always blame the agent when your market returns are disappointing—make sure first that there is no room for criticism with respect to the fruit and its get-up.

Such, in essence, was the advice of Mr. F. Chilton at the State conference of the New South Wales Agricultural Bureau. Discussing fruit marketing from the point of view of the agent, he expressed his desire to correct some of the misapprehensions of growers whose habit it was to blame the agent when results were not profitable. When the prices received did not equal those shown in the papers it was well to remember that there were always—even during periods of glutted markets and low prices—some grades and varieties which realised very fine prices, and the demand for this class of fruit was always greater than the supply. Not only was the production of more high-class fruit desirable, but there was considerable room for improvement in the way in which fruit was presented to the public. It was a common experience for fruit which was undoubtedly beautiful on the tree to arrive overripe or too green, badly packed, or perhaps ungraded. Summarised, Mr. Chilton's advice as to how to make the marketing of fruit more profitable for both agent and grower was—

1. Grow only the kinds and varieties of fruit that succeed in the district.
2. Try to cater for the market requirements as to size, type of case, &c.
3. Endeavour to become a specialist not only in the production of the fruit but in picking, packing, and grading it, and be strictly honest in marking the packages.
4. Advise the agent prior to maturity of the crop of the prospects for both quantity and quality.
5. Adopt the numerical system of packing, or, if using sizes, adopt ½-inch divisions in preference to ¼-inch.
6. Consider the possibilities of cold storage, and look ahead for other outlets for production than are at present available.

Discussing the use of different types of case for various fruits, Mr. Chilton said that grapes and plums seemed to do better in flat or hinged lid half-cases, while peaches, apricots, and nearly ripe pears found a congenial pack in the dump shape of half-case. The flat bushel or "packer" was often condemned for many fruits, but for pears, such as Beurre Bosc with long, awkward stalks, there was probably no better package. Thousands of bushels of Victorian apricots, peaches, and pears came to Sydney in this type of case and carried and kept well.

The time to expect a reduction in selling charges, he said in conclusion, would be when the fruit marketed in Sydney consisted of fewer varieties, and those the most suitable; when "special" was easier to find than "plain" grade, and when the packing and get-up generally were of the highest standard—then the average prices realised should be higher than to-day, the selling a much easier and quicker matter, and the business generally more satisfactory for grower, agent, and purchaser.

The Home and the Garden.

OUR BABIES.

Under this heading a series of short articles by the Medical and Nursing Staff of the Queensland Baby Clinics, dealing with the welfare and care of babies, has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable cases of infant mortality.

INFANTILE DIARRHŒA.

IT is not many years since large numbers of babies in Queensland died every year from diarrhœal diseases. During the years 1890 to 1903 every tenth baby born died before reaching its first birthday (from all causes). During the past five years this mortality has been reduced to a little below one in twenty. On our annual birthrate, which is not far from 20,000, this has meant the saving of nearly 1,000 lives every year, which is surely a remarkable fact. Diarrhœal diseases, often occurring in formidable epidemics in summer months, were the largest cause of the former high death rate. Infectious diarrhœa still causes a considerable number of preventable deaths, and if great care be not taken, a dangerous epidemic is still possible.

Our Best Defence.

Against this our best defence, and our only hope for reducing deaths from diarrhœa to a minimum, is a clear understanding of its causation. Unfortunately there has been no subject on which more obscurity, more confused thinking, more foolish traditions and absurd beliefs have been prevalent. All these have been a direct cause of the high mortality. Until recently nearly every mother when asked the cause of her baby's illness would reply, as a matter of course, "teething," and many think so still, though it is nonsense. This deadly nonsense has been the cause of innumerable infant deaths. Teething never killed anybody. Recently some mothers will tell us that the cause is "gastro-enteritis," or as they call it for short, "gastritis." Unfortunately, these are but names. They convey no knowledge, but hide much ignorance. They are just big words, which send the mind to sleep.

Let us try to make this matter so clear that even the simplest, if they will only attend, can understand. Diarrhœa is the passage of frequent loose or watery motions. It is caused by the presence of some irritating material in the bowels. The bowels are trying to expel this, and so the motions are frequent. The contents of the bowel are being hurried through, and so they are watery. All sorts of things will cause diarrhœa in babies, but we may divide them into two classes.

Food Diarrhœas.

These may occur in artificially fed babies at any time, but are more frequent during hot weather. The baby is given unsuitable food or more food than he can digest, so that the excess ferments inside. Sometimes the system of feeding is wrong. Sometimes his mother is feeding him carefully, but kind friends give him things he ought not to have. If he has learnt to crawl, he may have picked up some rubbish and swallowed it. Perhaps he is being given cow's milk which is stale or dirty and rapidly becomes irritating in hot weather. Perhaps he has been very thirsty on a hot day, and his mother, instead of giving him water, has given him too much milk. Perhaps he has had a feverish illness and his mother has kept him on full diet instead of giving him more water and less food. All these things cause diarrhœa. The treatment is very simple. Give him a teaspoonful of castor oil to help to clear out the irritating material. Give him no milk and stop all food, but let him drink plenty of very weak barley water. Keep him on this one, two, or three days. When he improves give him scalded whey made from junket. If over eight or nine months he may also have arrowroot, cornflour, or sago boiled with water, and if really hungry a small finger of baked bread. When his motions get right, add milk to his food gradually. So treated cost cases of food diarrhœa get well rapidly. Only long standing and neglected cases are obstinate, and sometimes

Infectious Diarrhœas.

These occur especially in the early summer and are a much more serious matter. Your baby has swallowed disease germs—living bacteria—which are the cause of his illness. Often the attack begins suddenly with high fever and much weakness. Often it begins gradually so that you may think it a simple food diarrhœa, but in spite of castor oil and barley water you find baby is no better next day, but worse. Medical treatment is urgently necessary in all these cases, and you should see a doctor at once.

But the responsibility for preventing these illnesses—for keeping germs from getting inside the baby—rests with his mother. If the baby is on the breast he runs very little risk with ordinary care. If he is bottle-fed, you must take the greatest care. Do not blame the milkman. Boiling or pasteurising kills all disease germs. Therefore the germs must have got into the milk after boiling or pasteurising. They were carried there by flies or by the mother's fingers, and they can be carried into foods made from dried or condensed milk just as easily. The flies may have deposited the germs on the rubber teats, or on the dummy, which you know the baby ought not to have. Constant care and watchfulness are the baby's safeguards. If you do not know how to keep the baby's food safe from infection, the nurse at the Baby Clinic will show you. Do not wait until your baby is sick, for then it may be too late.

THE COUNTRY WOMAN.

By arrangement with the Domestic Science and Technical Services of the Department of Public Instruction, information of especial interest to country women is published regularly under this heading.

Text booklets are available, free of cost, on application to that Department.

INVALID COOKERY.

LIQUIDS AND THEIR PREPARATION.

SECTION II.

A.—PEPTONISED FOODS.

B.—BEEF TEA.

Peptonised foods are useful to persons who suffer from severe indigestion or dyspepsia, to patients suffering from gastritis, or any other disease of the alimentary canal, and to those who are unable for other reasons to take milk in its natural form.

Pepsin and *liquor pancreatinus* are used to peptonise foods; if peptonising is properly carried out the food is partially predigested and is ready to be absorbed without further work on the part of the digestive organs.

When the natural digestive juices are deficient, the stomach and intestines are unable to perform their work; by using peptonising agents patients may be supplied with varied forms of nourishment which otherwise they would be unable to digest.

During the process of peptonisation a slightly bitter taste is developed; this bitterness may be checked before it becomes too pronounced—

(*a*) By quickly bringing the food acted upon to boiling point.

(*b*) By placing the food on ice.

PEPTONISED GRUEL.

Utensils—Saucepan; cup; wooden spoon.

Materials—½ pint thick gruel; ½ pint milk; 15 grains soda; 20 grains peptonising powder.

Method—

1. Make a pint of thick gruel.
2. Add milk; stir in soda and peptonising powder.
3. Keep the mixture warm for thirty minutes.
4. Bring to boiling point quickly; sweeten.

PEPTONISED BEEF TEA.

Utensils—Knife; spoon; saucepan; strainer.

Materials—½ lb. lean beef; 15 grains soda; ½ pint water; 20 grains peptonising powder.

Method—

1. Put water, finely shredded beef, and soda into a saucepan.
2. Bring slowly to blood heat, stirring gently.
3. Keep beef tea at this heat for thirty minutes.
4. Remove from fire; when tepid add peptonising powder.
5. Cover the saucepan; allow it to stand in a warm place for one hour.
6. Strain; bring the beef tea to boiling point quickly; season.

Notes—

1. The tube of peptonising powder contains 20 grains.
2. Twenty grains of peptonising powder are equal to half a level teaspoonful. The half-teaspoonful should be measured lengthways.

PEPTONISED MILK.

Utensils—Saucepan; jug; flannel cover.

Materials—½ pint milk; ¼ pint water; 15 grains soda; 20 grains peptonising powder.

Method—

1. Put milk and water into an enamelled stewpan.
2. Bring to blood beat; put peptonising powder and soda into a jug.
3. Pour warm milk into the jug.
4. Cover the jug; wrap it in flannel and keep it in a warm place for one hour.
5. Pour milk into a saucepan; bring it to boiling point quickly.

Note.—Milk thus prepared may be served hot or cold; it may also be used for various preparations.

FRUIT PRESERVING.

PLUM JAM.

Method—

1. Butter the bottom of a preserving pan slightly.
2. Wash plums well, wipe them dry; if large cut into halves and remove stones.
3. Break some of the stones and remove kernels.
4. Put a layer of fruit into the preserving pan, sprinkle with sugar, add kernels and small amount of water.
5. Add another layer of fruit and sugar, and so on.
6. Allow the preserving pan to stand near the fire till the juice begins to run.
7. Boil slowly for fifteen minutes, add remainder of sugar.
8. Boil till a small quantity sets on a cool plate.
9. Bottle, seal, and cover.

Utensils—Preserving pan, bowl, cloth, knife, chopper, board, wooden spoon, jars.

Materials—1 teaspoonful butter, ¼ to 1 lb. of sugar to each pound of fruit. The amount of sugar needed depends upon the acidity of the plums.

Notes.—

1. Half a pound of cooking apples stewed down to pulp in half a cup of water to each 5 lb. of plums may be put into the pan first.

2. The plums may be prepared twelve hours or more before the jam is made; if this is done they are cut into halves and stones removed, and the fruit is placed on a bowl in layers with sugar between the layers.

DRIED PLUMS

Method—

1. Wipe plums, split them lengthwise, remove seeds.
2. Place fruit on flat tins with the skin downwards.
3. Dry in a warm oven or in the sun; if the latter course is followed, cover the fruit with muslin to keep away the insects.
4. Turn frequently; keep the fruit exposed to moderate warmth till the moisture is evaporated.
5. Pack in boxes with white paper between layers.

Utensils—Knife, tins, boxes, white paper, muslin or net.

Materials—Plums.

MACEDOINE OF FRUIT.

Method—

1. Peel large fruit; cut each into even-sized pieces.
2. Remove seeds from small fruit with a quill, taking care not to alter the shape.
3. Put fruit into a preserving pan; cover with water, bring to boiling point, drain.
4. Make a heavy syrup in a preserving pan.
5. Add fruit to the syrup; simmer for fifteen minutes.
6. Pour into bowls; cover; allow to stand for twenty-four hours.
7. Put fruit and syrup into preserving pans; add sufficient freshly made syrup to cover fruit.
8. Simmer for five minutes.
9. Repeat 6, 7, and 8, three times.
10. Arrange fruit carefully in jars; fill jars with syrup; bottle and seal.

HEAVY SYRUP.

Method—

1. Put sugar, glucose, and water into a preserving pan.
2. Boil till a small portion of syrup taken between the fingers forms a thread.

Utensils—Knife, quill, or small corer, 3 bowls, preserving pan, wooden spoon.

Materials—Small mandarins, cherries, cumquats, plums, figs, pears, apricots, quinces, pineapple.

For Syrup—1 lb. sugar to ½ pint water, 1 teaspoonful glucose.

Note—Almost all fruits may be used in making this preserve.

PASSION-FRUIT JAM.

Method—

1. Wipe fruit well, cut each into halves.
2. Scoop out seeds and juice: put skins into a saucepan; add sufficient water to cover skins.
3. Boil till the skins are quite tender; remove pith from skins.
4. Put it into a preserving pan.
5. Add seeds, juice, lemon-juice, and sugar.
6. Boil slowly till jam sets.
7. Bottle while hot; cover down closely.

Utensils—Cloth, knife, teaspoon, bowl, saucepan, preserving pan, mincer, cup, jars.

Materials—Passion fruit; ½ teaspoonful lemon-juice, 1 cup sugar, to each cup of pulp.

FRUIT MINCEMEAT.

Method—

1. Wash, peel, and core apples.
2. Mince apples, candied peel, raisins, and currants.
3. Add sugar, cinnamon, nutmeg, spice, lemon-juice, and grated rind.
4. Mix well together with brandy.
5. Put into jars, cover down airtight.

Utensils—Knife, mincer or chopper, jars.

Materials—2 lb. apples; ½ lb. seedless raisins; ½ lb. currants; 1 teaspoonful of cinnamon; ½ nutmeg; 1 gill brandy; 1 lemon; ½ teaspoon spice; ¼ lb. peel.

November to March.

PRESERVED MANGOES.

Method—

1. Peel firm mangoes, cut them into thick slices.
2. Make a syrup of 1 lb. sugar to 1 quart of water.
3. Lay mango slices in the syrup, bring to boiling point.
4. Lift fruit out, pack into jars.
5. Boil up syrup for twenty minutes; remove scum.
6. Strain syrup over mangoes in jar till the jars overflow.
7. Seal down and test.

Utensils—Knife, preserving pan, strainer, flannel, bowl, jug, cup, jars.

Materials—Mangoes; 1 lb. sugar and 1 quart water.

MANGO CHUTNEY.

Method—

1. Peel and slice perfectly firm, ripe mangoes; they must be neither green nor over-ripe.
2. Put them into a preserving pan; add vinegar, apples, seedless raisins, brown sugar, garlic, mustard seed (tied in a muslin bag), salt, cayenne, and ground ginger.
3. Boil slowly until the fruit is tender.
4. Bottle and cover.

Utensils—Knife, preserving pan, wooden spoon, bottles, muslin bag.

Materials—To each pound of mango pulp allow ½ lb. apples, 1 pint vinegar, ¼ lb. seedless raisins, ½ lb. brown sugar, 2 oz. garlic, 2 oz. mustard seed, 2 oz. salt, 1 oz. ground giner, ½ oz. cayenne.

Note.—Dates, sultanas, and preserved ginger may be used.

MANGO SAUCE.

To the above mixture add 1 pint of limejuice to each pound of mango pulp; cook till tender; rub through a sieve; bottle and cover down.

Utensils as above with a sieve added.

Materials as above with 1 pint limejuice to each pound of pulp.

PAPAW AND APPLE OR PINEAPPLE JAM.

Method—

1. Peel papaw and apple; remove seeds.
2. Cut fruit into small pieces; put it into a preserving pan; add water.
3. Simmer till the apple is tender.
4. Add sugar and lemon-juice.
5. Boil till a small quantity jellies on a plate.
6. Bottle, seal, and cover down.

Materials—For every pound of papaw take ½ lb. of pineapple or cooking apples, 2 teaspoonfuls lemon-juice, and 1½ lb. sugar.

PRESERVED PAPAW.

Method—

1. Peel papaws; remove seeds; cut fruit into convenient pieces.
2. Proceed as for pears or pineapples.

Utensils—Knike, preserving pan, jars.

Materials—Papaws; 1 cup sugar to 1 cup water.

LAUNDRY WORK.

Treatment of Blankets.

Notes—

New flannels and blankets are often very difficult to wash on account of the sulphur they contain. To remove it they must be steeped in a soft lather of tepid water, melted soap, and ammonia. They can then be washed in the usual way. A breezy day should be chosen for washing blankets in order that they may be dried quickly.

Treatment of Stockings

Notes—

1. Stockings are the only woollen garments to which soap is applied directly; the soles may be rubbed with soap to make them perfectly clean. They must be turned inside out and washed till they become perfectly soft.
2. Stockings must not be washed in water which has been used for white flannel, because the fluff from the flannel sticks to the stockings.
3. After washing, they should be folded along the back seam, passed through a wringer, and hung out by the toes to dry.

Treatment of Coloured Prints and Muslins.

1. Wash the clothes in lukewarm water and melted soap.
2. Squeeze them between the hands. Do not rub them.
3. Rinse them in clean water to which 1 tablespoonful of salt and vinegar for each gallon of water have been added.
4. Stiffen with boiled starch.
5. Fold evenly and pass through a wringer.
6. Dry quickly out of the sun.
7. Damp with warm water.
8. Iron with a moderately hot iron.
9. Fold and air well.

Notes—

1. Pink and blue fade quickly if very hot water is used or if the garment is dried in the sun.
2. Green has a tendency to "run." To check this, before washing the garment should be steeped in water to which 1 tablespoonful of salt to 4 quarts of water has been added.
3. Soap must not be rubbed on coloured garments, because the soda in it affects the colours.
4. Coloured prints and muslins are not as a rule boiled. Some shirting is guaranteed to stand boiling, but it is better to test the material before boiling.
5. Coloured articles must never be allowed to lie about damp.
6. Prints and muslins should be ironed on the right side, unless there is a raised pattern in them. In this case they must be ironed on the wrong side.

Starching, Ironing, and Glossing of Shirts and Collars.

1. Collars, cuffs, and stiff shirt fronts must be starched in cold starch before being ironed.
2. Every article must be perfectly clean and dry. All old starch must be removed. Boiling is the only effective method of removing starch.
3. One tablespoonful of starch is sufficient for six collars or four collars and one pair of cuffs.
4. Stir the starch well from the bottom of the basin.
5. Dip each article into the starch separately, squeeze the starch out of it, and rub it between the hands to get the starch well into the material. Repeat the processes of dipping, squeezing, and rubbing.

6. Starch the cuffs of a shirt first, then the stiff front, taking care that the starch does not get into the body part.

7. Place collars and cuffs separately on a clean cloth, and roll all up tightly.

8. Place the cuffs on the stiff front, and roll up tightly.

9. Allow collars, cuffs, and shirts after being starched to lie in a cool place as long as possible before being ironed.

10. *In ironing collars and cuffs*—

(*a*) Take one collar or a cuff out of the cloth, place it flat on the ironing table, wipe each side with a clean cloth to remove specks, and push any fullness from top to bottom. A bone paper-knife is useful for smoothing down fullness.

(*b*) Take a good hot iron, rub it on wax to prevent sticking, and test it on a piece of calico.

N.B.—1. If the iron is too hot it causes small creases which cannot be removed, and the linen is said to "mackerel."

2. If the iron is too cool, the linen will not become stiff, because the heat is not sufficient to burst the starch grains.

(*c*) Iron lightly over the wrong side of the collar or cuff two or three times.

(*d*) Iron heavily on the right side, pressing out creases.

(*e*) Iron on both sides till perfectly stiff and dry, and polish.

(*f*) Put the iron across the left hand end of the wrong side of the collar, and pull the collar sharply through, pressing the iron down with the right hand. If this be done quickly the collar will "curl" correctly.

11. *In ironing a shirt*—

(*a*) Follow directions given in 10 (*b*).

(*b*) Iron the neckband and yoke on both sides.

(*c*) Iron cuffs and sleeves. For cuffs see 10 (*c*) (*d*) (*e*).

(*d*) Fold down the centre of back and iron on both sides.

(*e*) Flatten out back, smooth it carefully, and put in pleats if necessary.

(*f*) Arrange front evenly on the back, and iron the soft front.

(*g*) Place the shirt board under the stiff front, and iron the stiff front carefully, drying it thoroughly.

(*h*) Gloss the stiff front and cuffs. Fold and air well.

12. *To gloss or polish collars, cuffs, and shirt fronts*—

(*a*) Heat the glossing or polishing iron.

(*b*) Clean it thoroughly—the slightest speck of dirt spoils the work.

(*c*) Damp the outer layer of linen very lightly and quickly with a clean cloth dipped in cold water.

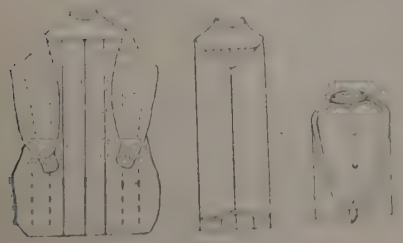
(*d*) Place the linen on an uncovered polishing board.

(*e*) Rub quickly and heavily, in one direction only, the surface of the linen until it is bright and polished.

N.B.—1. Badly ironed or speckled linen should not be glossed, as glossing only makes defects more noticeable.

2. Chemical preparations are sold for glossing. Great care must be taken when using them, as they are usually inflammable, consequently the linen may be scorched and discoloured.

13. *Diagrams illustrating the folding of a shirt*—



Note.—The cuffs may be folded back so as to appear between the folds on the yoke.

The Washing and Finishing of Laces and Chiffons.

1. White lace should be steeped in cold water to which borax has been added. The proportion of borax to be used is:—1 teaspoonful of rock borax dissolved in 1 tablespoonful of hot water and added to 1 quart of water.
2. Squeeze the borax water out of the lace.
3. Wash the lace in warm water to which melted white soap has been added. Do not rub the lace, but squeeze it gently between the hands.
4. Rinse it in clean warm water.
5. Stiffen it with thin boiled starch, rice water, or gum water.

N.B.—

(*a*) To make rice water, boil 1 tablespoonful of rice in 1 pint of water until the water becomes milky in appearance; and strain the liquid for use as required.

(*b*) To make gum water, put 1 oz. of gum arabic into a jar, add ½ a pint of cold water, stand the jar in a saucepan half-filled with water, keep the water in the saucepan simmering over the fire until the gum is dissolved, strain through muslin, and bottle for use. From 1 teaspoonful to 1 tablespoonful may be added to 1 pint of cold water. For silk laces, gum water only should be used for stiffening purposes.

6. When the laces are clean and stiffened, fold each length evenly and place it between layers of clean white cloth. Mangle several thicknesses at the same time.
7. Iron laces that may be ironed on the wrong side only, pressing out the points with the toe of the iron.
8. Maltese and Honiton lace should not be ironed. They should be pinned carefully by the pattern on a board and left until dry.
9. Chiffon may be washed in the same way as lace, or, after soaking, it may be put into a wide-necked bottle with soap lather and well shaken. In this way handling is avoided. Iron chiffon first with a thin cloth between it and the iron.
10. Black lace may be washed in strong tea. Melted soap should be added if the article is very dirty. Rinse in tea to which gum water has been added, and iron with a cloth between iron and lace to prevent a glazed appearance.

The Washing and Ironing of White Silks.

1. If the silk or ribbon is very dirty, soak it in the same way as lace is treated.
2. Wash it in warm soapy lather, taking care in the case of corded silk not to crack the grain. Squeeze it between the hands or rub it gently with a soft brush.
3. Rinse it in clean water.
4. Stiffen it by using 1 dessertspoonful of gum water to 1 pint of cold water.

Note.—The same proportion of methylated spirit may be added to increase the brightness of the silk.

5. Place the silk between layers of clean calico and mangle it.
6. Iron first with a clean cloth between the iron and silk, using only a moderately hot iron.

The Washing and Ironing of Coloured Silks.

1. Coloured silk and chiffon may be washed in the same way as white with these exceptions—

(*a*) Add salt to the steeping and rinsing waters.

(*b*) Steep only for a few minutes.

(*c*) The water in which they are washed and rinsed must be nearly cold.

(*d*) One tablespoonful of vinegar may be added to the rinsing water to revive the colour.

(*e*) Quick washing and rinsing are necessary to preserve the colour, and the silk or chiffon must be ironed immediately after it has been washed.

2. Black ribbon may be washed in the same way as black lace. See 10 of Laces and Chiffons.

Bran Washing.

1. Embroidered linen and canvas, especially the unbleached varieties, may be washed in bran water. This process gives them a slight stiffness and helps to retain the natural shade.
2. To make bran water—
   (*a*) Add 1 breakfastcupful of bran to 2 quarts of cold water.
   (*b*) Boil the mixture for ten minutes, removing scum as it rises.
   (*c*) Strain, and add 1 quart of cold water.
   (*d*) Use for washing and rinsing the materials.

Laundry Preparations.

Prussian Blue is a compound of iron, carbon, and nitrogen. Clothes treated by it show rust stains if soap or soda is not entirely removed in the rinsing water

Ultramarine Blue is dearer than Prussian blue, but gives more satisfactory results.

Washing Powders are mixtures of soda, borax, and soap.

Bleaching Powder is made by absorbing chlorine with slaked lime.

Javelle Water or Washing Fluid is made by mixing 1 lb. of soda and ½ lb. of chloride of lime in 5 quarts of water. After the liquid has settled the clear part is poured off and bottled.

Soap is a combination of fat, water, and an alkali. Good hard laundry soap may be made from clean tallow or dripping and caustic soda.

To Make Soap.

Materials—

3 lb. clean dripping; 1 tin caustic soda; 1½ pint cold water; 1½ oz. pearl ash dissolved in 1½ pint hot water.

Method—

1. Melt the dripping in a large pan or saucepan.
2. Dissolve the caustic soda in 1½ pint cold water.
3. Add the dissolved caustic soda to the dripping; stir well.
4. Allow to stand for 24 hours.
5. Cut up the solidified mixture.
6. Add dissolved pearl ash.
7. Melt over a slow fire.
8. Pour the melted mixture into a box lined with a damp cloth.
9. When solid, cut into bars.

Cleansing agents in general—

Dirt may be removed in various ways—

(*a*) Dry dust may be removed by beating, shaking, brushing.

(*b*) Dirt that is soluble in water, such as dirt combined with sugar, may be removed by washing in water. Hot water is better than cold for this purpose, as it has greater solvent powers. Soap may assist by loosening the dirt.

(*c*) Grease may be converted into a soluble soap and removed by washing with water to which soda has been added.

(*d*) Colouring matters, such as stains, may be removed or bleached by the action of bleaching powder.

Toilet Soap.

Dissolve 1 lb. of caustic soda in 3 pints water, stir occassionally. Melt 6½ lb. unsalted fat or lard and let it cool till both caustic soda and fat are just warm. Then pour the soda and water into the fat very slowly, stirring all the time with a flat stick or wooden spoon till the mixture is like honey. Pour into a tub or tin and leave till next day. Then stir up this soap quickly, add 2½ quarts of water and 1 lb. refined pearl ash. Melt all slowly till the soap is thoroughly dissolved. When the mixture has cooled a little add ½ oz. essential oil of lavender or bergamot. When set, cut up and put aside for a few weeks to harden. Pearl ash is very cheap and can be obtained from any chemist.

Orchard Notes for January.

THE COASTAL DISTRICTS.

ALL orchards, plantations, and vineyards should be kept well cultivated and free from weed growth; in the first place, to conserve the moisture in the soil, so necessary for the proper development of all fruit trees and vines; and, secondly, to have any weed growth well in hand before the regular wet season commences. This advice is especially applicable to citrus orchards, which frequently suffer from lack of moisture at this period of the year if the weather is at all dry, and the young crop of fruit on the trees is injured to a greater or less extent in consequence.

Pineapple plantations must also be kept well worked and free from weeds, as when the harvesting of the main summer crop takes place later on, there is little time to devote to cultivation. If this important work has been neglected, not only does the actual crop of fruit on the plants suffer, but the plants themselves receive a setback.

Banana plantations should be kept well worked, and where the soil is likely to wash badly, or there is a deficiency of humus, a green crop for manuring may be planted. Should the normal wet season set in, it will then soon cover the ground without injury to the banana plants. When necessary, banana plantations should be manured now, using a complete manure rich in potash and nitrogen. Pineapples may also be manured, using a composition rich in potash and nitrogen, but containing no acid phosphate (superphosphate) and only a small percentage of bonemeal, ground phosphatic rock, or other material containing phosphoric acid in a slowly available form.

Bananas and pineapples may still be planted, though it is somewhat late for the former in the more southern parts of the State. Keep a good lookout for pests of all kinds, such as Maori on citrus trees, scale insects of all kinds, all leaf-eating insects, borers, and fungus pests generally, using the remedies recommended in Departmental publications.

Fruit fly should receive special attention, and on no account should infested fruit of any kind be allowed to lie about on the ground to become the means of breeding this serious pest. If this is neglected, when the main mango crop in the South and the early ripening citrus fruits are ready, there will be an army of flies waiting to destroy them.

Be very careful in handling and marketing of all kinds of fruit, as it soon spoils in hot weather, even when given the most careful treatment. Further, as during January there is generally more or less of a glut of fresh fruit, only the best will meet with a ready sale at a satisfactory price.

Grapes are in full season, and in order that they may be sold to advantage they must be very carefully handled, graded, and packed, as their value depends very much on the condition in which they reach the market and open up for sale. Well-coloured fruit, with the bloom on and without a blemish, always sells well, whereas badly coloured, immature, or bruised fruit is hard to quit.

One of the greatest mistakes in marketing grapes is to send the fruit to market before it is properly ripe, and there is no better way to spoil its sale than to try and force it on the general public when it is sour and unfit to eat.

Bananas for sending to the Southern States require to be cut on the green side, but not when they are so immature as to be only partially filled. The fruit must be well filled but show no sign of ripening; it must be carefully graded and packed and the cases marked in accordance with the regulations under the Fruit Cases Acts and forwarded to its destination with as little delay as possible.

Pineapples should be packed when they are fully developed, which means that they contain sufficient sugar to enable the fruit to mature properly. Immature fruit must not be marketed, and if an attempt is made to do so the fruit is liable to seizure and the sender of the fruit to prosecution under the abovenamed regulations. Further, the fruit must be graded to size and the number of fruit contained in a case must be marked thereon. Immature fruit must not be sent. For canning, the fruit should be partly coloured: immature fruit is useless; and overripe fruit is just as bad. The former is deficient in colour and flavour and the latter is "winey" and of poor texture, so that it will not stand the necessary preparation and cooking.

Should there be a glut of bananas, growers are advised to try and convert any thoroughly ripe fruit into banana figs.

The fruit must be thoroughly ripe, so that it will peel easily, and it should be laid in a single layer on wooden trays and placed in the sun to dry. If the weather is settled, there is little trouble, but if there is any sign of rain the trays must be stacked till the weather is again fine, and the top of the stack protected from the rain. To facilitate drying, the fruit may be cut in half lengthways. It should be dried till a small portion rubbed between the finger and thumb shows no sign of moisture. It can be placed in a suitable box to sweat for a few days, after which it can be dipped in boiling water to destroy any moth or insect eggs that may have been laid on it during the process of drying and sweating. It is then placed in the sun to dry off any moisture, and when quite dry it should be at once packed into boxes lined with clean white paper. It must be firmly packed, when, if it has been properly dried, it will keep a considerable time. It can be used in many ways, and forms an excellent substitute for raisins, sultanas, currants, or other dried fruits used in making fruit cakes and other comestibles. Banana figs will be found useful for home consumption, and it is possible that a trade may be built up that will absorb a quantity of fruit that would otherwise go to waste.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

JANUARY is a busy month in the Granite Belt, and orchardists are fully occupied gathering, packing, and marketing the crop of midseason fruits, consisting of plums of several kinds, peaches, nectarines, pears, and apples. The majority of these fruits are better keepers and carriers than those that ripen earlier in the season; at the same time, the period of usefulness of any particular fruit is very limited, and it must be marketed and disposed of with as little delay as possible.

With the great increase in production, owing to the large area of new orchards coming into bearing and the increasing yields of those orchards that have not come into full profit, there is not likely to be any market for immature or inferior fruit. There will be ample good fruit to fully supply the markets that are available and accessible. Much of the fruit will not carry far beyond the metropolitan market, but firm-fleshed plums, clingstone peaches, and good firm apples should stand the journey to the Central District, and, if they are very carefully selected, handled in a manner to prevent any bruising, and properly graded and packed, they should carry as far as Townsville. Growers must remember that, given a market fully supplied with fruit, only such fruit as reaches that market in first class condition is likely to bring a price that will pay them; consequently the grower who takes the trouble to send nothing but perfect fruit, to grade it for size and colour, to pack it carefully and honestly, placing only one-sized fruit, of even quality and even colour, in a case and packing it so that it will carry without bruising, and, when opened up for sale, will show to the best advantage, is pretty certain of making good. On the other hand, the careless grower who sends inferior, badly graded, or badly packed fruit is very likely to find when the returns for the sale of this fruit are to hand that after paying expenses there is little, if anything, left. The expense of marketing the fruit is practically the same in both cases.

Then why "spoil the ship for a ha'p'orth of tar" after you have gone to the expense of pruning, spraying, manuring, and cultivating your orchard? Why not try and get a maximum return for your labour by marketing your fruit properly? The packing of all kinds of fruit is a fairly simple matter, provided you will remember—

(1) That the fruit must be fully developed, but yet quite firm when gathered.

(2) That it must be handled like eggs, as a bruised fruit is a spoilt fruit, and, when packed with sound fruit, spoils them also.

(3) That only one-sized fruit, of an even degree of ripeness and colour, must be packed in a case.

(4) That the fruit must be so packed that it will not shift, for if it is loosely packed it will be so bruised when it reaches its destination that it will be of little value. At the same time, it must not be packed so tightly as to crush the fruit.

If these simple rules are borne in mind, growers will find that much of the blame they frequently attribute to the fruit merchants or middlemen is actually the result of their own lack of care. Fruit that opens up in the pink of condition sells itself, whereas any fruit that opens up indifferently is hard to sell on any except a bare market, and on a glutted market is either unsaleable or realises such a poor price that the grower is frequently out of pocket and would have been better off had he not attempted to market it.

If spraying with arsenate of lead, and systematic bandaging, has been properly carried out, there will be comparatively few codlin moths to destroy the later ripening pip fruits; but if these essential operations have been neglected or carelessly carried out a number of moths will hatch out and the eggs laid by them will turn to larvæ that will do much damage, in some cases even more than that caused by the first broods that attack the fruit as soon as it is formed. Where there is any likelihood, therefore, of a late crop of moths, spraying with arsenate of lead must be continued if the late crop of pip fruits is to be kept free from this serious pest.

Fruit fly must be systematically fought, and on no account must any fly-infected fruit be allowed to lie about on the ground and breed this pest, to do further damage to the later ripening fruits.

Citrus orchards will need to be kept well cultivated in the drier and warmer parts of the State, and, where necessary, the trees should be irrigated. If scale insects are present, the trees should be either sprayed, or, better still, treated with hydrocyanic acid gas.

Western grapes are in full season, and if they are to be sent long distances by rail then they are all the better to be cut some hours before they are packed, as this tends to wilt the stems and keep the berries from falling off in transit. The fruit must be perfectly dry when packed, and should be as cool as possible. It must be firmly packed, as a slack-packed case always carries badly and the fruit opens up in a more or less bruised condition.

Farm Notes for January.

FIELD.—The main business of the field during this month will be ploughing and preparing the land for the potato and other future crops, and keeping all growing crops clean. Great care must be exercised in the selection of seed potatoes to ensure their not being affected by the Irish blight. Never allow weeds to seed. This may be unavoidable in the event of long-continued heavy rains, but every effort should be made to prevent the weeds coming to maturity. A little maize may still be sown for a late crop. Sow sorghum, imphee, Cape barley, vetches, panicum, teosinte, rye, and cowpeas. In some very early localities potatoes may be sown, but there is considerable risk in sowing during this month, and it may be looked upon merely as an experiment. Plant potatoes whole. Early-sown cotton will be in bloom.

On coastal and intercoastal scrub districts, where recently burnt-off scrub lands are ready for the reception of seed of summer-growing grasses, sowing may commence as soon as suitable weather is experienced. Much disappointment may be saved, and subsequent expenditure obviated, by ensuring that only good germinable grass seed is sown, of kinds and in quantities to suit local conditions, the circumstances being kept in mind that a good stand of grass is the principal factor in keeping down weeds and undergrowth.

In all districts where wheat, barley, oats, canary seed, and similar crops have recently been harvested, the practice of breaking up the surface soil on the cropped areas should invariably be adopted. Soil put into fit condition in this way will "trap" moisture and admit of the rains percolating into the subsoil, where the moisture necessary for the production of a succeeding crop can be held, provided attention is given to the maintenance of a surface mulch, and to the removal, by regular cultivation, of volunteer growths of all kinds. If not already seen to, all harvesting machinery should be put under cover, overhauled, and the woodwork painted where required.

Where maize and all summer-growing "hoed" crops are not too far advanced for the purpose, they should be kept in a well-cultivated condition with the horse hoe. Young maize and sorghum crops will derive much benefit by harrowing them, in the same direction as the rows are running, using light lever harrows with the tines set back at an angle to obviate dragging out of plants, but the work should not be done in the heat of the day.

Quick-maturing varieties of maize and sorghum may still be sown in the early part of the month in coastal areas where early frosts are not expected.

Succession sowings may be made of a number of quick-growing summer fodder crops—Sudan grass, Japanese and French millet, white panicum, and liberty millet (panicum). In favourable situations, both "grain" and "saccharine" sorghums may still be grown; also maize, for fodder purposes.

Fodder conservation should be the aim of everyone who derives a living from stock, particularly the dairyman; the present is an important period to plan cropping arrangements. Exclusive of the main crops for feeding-off (when fodder is suitable for this purpose), ample provision should be made for ensilage crops to be conserved in silo or stack. As natural and summer-growing artificial grasses may be expected to lose some of their succulence in autumn, and more of it in winter and early spring, the cropping "lay-out" to provide a continuity of succulent green fodder throughout the season calls for thorough and deep cultivation and the building up of the fertility and moisture-holding capacity of the soil. Planter's friend (sorghum) may be sown as a broadcast crop at the latter end of the month for cutting and feeding to cattle in the autumn and early winter. Strips of land should be prepared also for a succession sowing about the second week in February, and for winter-growing fodder crops.

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ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON, F.R.A.S., AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	December, 1931.		January, 1932.		MOONRISE. Dec., 1931.	Jan., 1932.
Date.	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					p.m.	p.m.
1	4.52	6.30	5.3	6.47	11.41	11.55
2	4 52	6.30	5 3	6.47	...	...
					a.m.	a.m.
3	4.52	6.31	5.4	6.47	12.16	12.30
4	4 53	6.32	5.4	6.48	12.48	1.5
5	4 53	6.33	5.5	6.48	1.21	1.53
6	4.53	6.34	5.6	6.48	1.54	2 47
7	4 53	6.34	5.6	6 49	2.31	3.46
8	4 53	6 35	5.7	6.49	3.13	4.49
9	4 53	6.35	5.8	6.49	4.4	5.51
10	4 54	6.36	5.9	6.49	5.2	6.51
11	4 54	6.37	5.9	6 49	6.4	7.51
12	4 54	6 38	5 10	6 49	7.7	8.48
13	4 54	6 38	5 11	6 49	8.8	9.45
14	4 54	6.39	5.12	6 48	9 9	10.35
15	4.54	6.39	5 13	6.48	10.8	11.24
						p.m.
16	4.55	6.40	5 14	6.48	11.1	12.18
17	4 55	6.40	5 15	6.48	11.54	1.3
					p.m.	
18	4.56	6.41	5.16	6 48	12 42	2.11
19	4.56	6 41	5.17	6.47	1.34	3.7
20	4 57	6.42	5.17	6.47	2.30	4.5
21	4.57	6.43	5 18	6.47	3.25	5.4
22	4 58	6.43	5.19	6.47	4.24	6.0
23	4 58	6.44	5 20	6.47	5.21	6.51
24	4.59	6 44	5 21	6 47	6.19	7 37
25	4.59	6.45	5.21	6.46	7.17	8 15
26	5.0	6 45	5.22	6.46	8.11	8.50
27	5 0	6.46	5.22	6.46	9.0	9.23
28	5.1	6 45	5.23	6.46	9.41	9 56
29	5.1	6.46	5.24	6.45	10.16	10.30
30	5.2	6.47	5.24	6.45	10 50	11 7
31	5.3	6.47	5.25	6.45	11.23	11.49

Phases of the Moon, Occultations, &c.

3 Dec.	☽	Last Quarter	2	51 a.m.
9 „	●	New Moon	8	16 p.m.
17 „	☾	First Quarter	8	43 a.m.
25 „	○	Full Moon	9	24 a.m.

Perigee, 7th December, 4.6 a.m...
Apogee, 18th December, 9.42 pm

By the middle of December Mercury and Mars will be closer together with the more brilliant Venus above them, nearer to the stars in the bow of Sagittarius and Saturn about the length of the Southern Cross higher up.

The Moon, being absent for the first 10 days, then with only a narrow part of her disc illuminated by the 15th, opportunity will be afforded to watch the movements of the three planets favourably. So quickly will Mercury change its position with regard to the Sun that it will be passing from east to west of the latter on the 21st, although it will be above the horizon with Mars and Venus for an hour after the Sun on the 15th.

By the end of the month Mercury will be no longer visible in the evening. Mars, too, will disappear soon after the setting of the Sun; but Venus, with increased brilliance, will have passed Saturn on the 19th and crossed the eastern border of Sagittarius, apparently into Capricornus.

Early in the morning of the 23rd the Sun will reach its furthest distance south of the celestial equator and our summer solstice will occur.

Mercury will set at 8.10 p.m. on the 1st, and at 7.38 p.m. on the 15th.

Venus will set at 8.8 p.m. on the 1st, and at 8.28 p.m. on the 15th.

Mars will set at 7.43 p.m. on the 1st, and at 7.32 p.m. on the 15th.

Jupiter will rise at 11.30 p.m., and set at 10.26 a.m. on the 1st; on the 15th it will rise at 10.34 p.m., and set at 9.31 a.m.

Saturn will rise at 7.56 a.m., and set at 9.34 p.m. on the 1st; on the 15th it will rise at 7.7 a.m., and set at 8.45 p.m.

On Christmas Day the Moon, though full, will not rise till about half an hour after sunset. When it reaches its highest point, the meridian, about midnight it will be more than half way down towards the northern horizon, everywhere south of Cairns.

The Southern Cross will be erect and at position XII. at 8 a.m. on December 1, and at VI., its lowest position, at 8 p.m. At the end of the month it will be at these positions two hours earlier.

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1 Jan.	☽	Last Quarter	11	23 a.m.
8 „	●	New Moon	9	29 a.m.
16 „	☾	First Quarter	6	55 a.m.
23 „	○	Full Moon	11	44 p.m.
30 „	☽	Last Quarter	7	32 p.m.

Perigee, 2nd January, 8.48 p.m.
Apogee, 15th January, 7.6 p.m.
Perigee, 27th January, 7.0 p.m.

Spica, the brightest star in Virgo, will be occulted by the Moon on the 2nd and the 29th, but on both occasions the Moon and planet will be below the horizon in Queensland. The occultation on the 5th of Antares, the brightest star in the Scorpion, will also be invisible.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S., add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhat about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

[All the particulars on this page were computed for this Journal, and should not be reproduced without acknowledgment.]